APPENDIX O

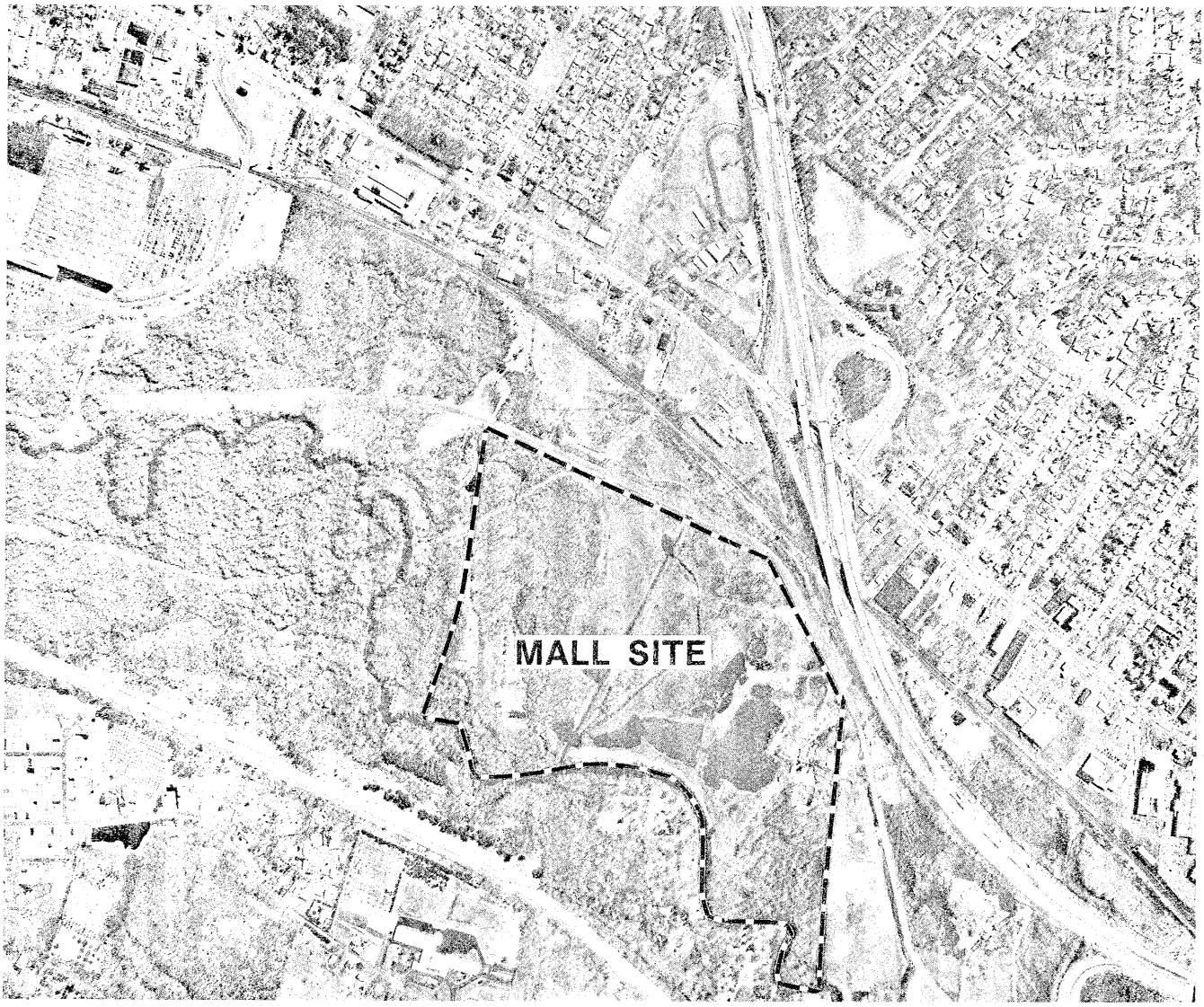
Phase I and Phase II Archaeological Investigations

APPENDIX P

Energy

NORTH HAVEN MALL

NORTH HAVEN, CONNECTICUT



1981

US Army Corps of Engineers

New England Division

Appendix O

Phase I and Phase II, Archaeological Investigations

The material contained in this appendix was prepared for Mall Properties, Inc., by Public Archaeology Survey Team in association with Jason M. Cortell and Associates, Inc. It has been provided to the Corps of Engineers as information in support of application #13-79-561 for a permit under Section 404 of the Clean Water Act of 1977, and Section 10 of the River and Harbor Act of 1899.

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PHASE I and PHASE II
ARCHAEOLOGICAL INVESTIGATIONS

APPENDIX O

NORTH HAVEN MALL
North Haven, Connecticut

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July 1981

WALTHAM, MASSACHUSETTS • GLADSTONE, NEW JERSEY

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1.0 INTRODUCTION

1.1 Purpose

A Phase I and Phase II archaeological investigation was conducted for historic and prehistoric cultural remains in the vicinity of the proposed North Haven Mall and its related access and service facilities, North Haven, Connecticut. The site of the proposed project consists of approximately 117 acres, bounded on the west by the Quinnipiac River, and on the east by Valley Service Road. The area of study consists of approximately 20 acres of undisturbed land just north of an area which has been the site of mining and quarrying activities. The study area averages approximately 430 meters (1,300 ft) in width, and 630 meters (1,900 ft) in length. In addition, areas associated with the proposed transportation improvements and service facilities were also investigated. These areas include the land associated with the proposed widening of Valley Service Road, the proposed jughandle area just south of Route 5/22, and the location of the proposed Mall Drive between Valley Service Road and Washington Avenue.

The specific study area on the project site was based on a determination by the U.S. Army Corps of Engineers (ACOE), dated March 27, 1980, that approximately 75 percent of the permit area (project site) can be documented as devoid of significant cultural resources due to its heavily disturbed character. The ACOE also determined that only approximately the northern 25 percent of the permit area, and possibly some isolated strips of land bordering the former gravel pits, were undisturbed. Thus, ACOE recommended cultural resource investigations only for those undisturbed portions of the project site. The areas delineated by the ACOE are primarily upland areas occurring north of the drainage channel which transects the project site. A surface examination of the entire project area confirmed the Corp's determination regarding cultural resource potential.

1.2 Background

A Phase I Archaeological Reconnaissance Survey seeks to locate and identify any and all prehistoric and historic archaeological remains within the study area. According to the applicable regulations, archaeological sites discovered must be evaluated in a Phase II intensive survey to determine if they are eligible for nomination to the National Register of Historic Places. In a Phase I survey, a site is defined as any locus that yields definite evidence of human activity. For example, the recovery of a projectile point and a quantity of debitage (stone debris produced from tool manufacture) from tool-making would constitute a site, but the recovery of a single isolated flake may not. Inherent within the Phase I study is the location and evaluation of archaeological sites which can aid in the development of models. These models may be able to predict the location, function, and cultural affiliation of other prehistoric and historic sites, and therefore aid in cultural resource management. Such regional research design concepts represent a state-of-the-art approach to archaeological investigation.

In a Phase II investigation, emphasis is placed upon determining the extent of the sites, as well as upon assessing the integrity of the sites and the quality of the material recovered. Criteria for evaluating a site's eligibility for the National Register, as promulgated in 36 CFR 60, are cited below.

> "The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:
>
> a. that are associated with events that have made a significant contribution to the broad patterns of our history; or
> b. that are associated with the lives of persons significant in our past; or
> c. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
> d. that have yielded, or may be likely to yield, information important in prehistory or history."

The Phase I and Phase II archaeological investigations were implemented to comply with applicable regulations regarding historic and prehistoric cultural remains.

2.0 PHASE I ARCHAEOLOGICAL INVESTIGATIONS

2.1 Methodology

In accordance with applicable guidelines (36 CFR 60), the archaeological research comprised the investigative tasks discussed below. An overview of the research goals and objectives for both the Phase I and Phase II studies is presented in Attachment A.

Recorded inventories of archaeological sites contained in the files of the Connecticut Historical Commission were consulted to determine if any known sites were located in the project area and to facilitate preliminary predictions about the location of other archaeological remains within the area. Published and unpublished manuscripts dealing with the archaeology and recorded history of the area were also studied to provide a regional context for prehistoric and historic events in the area. In addition, information obtained by The Preservation Partnership, historical consultants, was reviewed in relation to the likelihood of historical sites occurring in the study area. Interviews with local property owners, interested individuals, and members of local historical societies were conducted to ascertain any information on collections of archaeological materials from the study area. The principle sources consulted are included in the bibliography, Section 5.0.

Fieldwork was designed to define the historic and prehistoric archaeological potential of the area to be disturbed by the construction of the North Haven Mall. Archaeological potential was determined by assessing past and present uses of the land, past and present ecological variables, the extent of past and present disturbance, and the nature of the proposed construction activity. A two-stage reconnaissance survey was conducted for the entire project area, consisting of a systematic surface walkover followed by a program of subsurface testing. Both stages are necessary because although surface survey procedures may be adequate for the location of architectural remains and archaeological features dating to the historic period, they do not reliably indicate prehistoric site locations in the Northeast, due to environmental conditions and the nature of the prehistoric remains.

A surface examination of the project area was conducted by the survey team. The project area was examined for any surface features that might indicate the presence of archaeological sites. Environmental variables such as vegetation, soil types, quality of drainage, degree of slope, and the extent and nature of modern disturbances were assessed and recorded (See Attachment B). Surface remains from historic and prehistoric activities were collected and assessed in terms of the overall sensitivity of the area.

Following the topographic and environmental overview of the area, the project area's sensitivity to the presence of archaeological resources was assessed according to a ranking system which characterized an area as having low, moderate, or high archaeological potential. In some cases, a single area may have more than one level of sensitivity.

Criteria of soil drainage, slope, and proximity to water were used in part to assess the archaeological potential of any given area. Sections characterized by: 1) well or moderately drained soils on 2) slopes of less than 10 percent, with 3) a stream, swamp, or pond within 0.2 miles were judged to have a high site potential. If one or two of these topographic criteria were not met, the area was considered to have moderate archaeological potential.

Inundated areas were classified as areas of low archaeological potential. Very steep slope gradients were also considered to reduce an area's archaeological potential. Areas of extensive subsurface disturbance as a consequence of commercial development, soil removal operations, etc. were classified as having low potential for the location of prehistoric sites.

Assessment of historic site potential was based on more limited criteria. Surface finds of 18th and 19th century materials or documentary evidence of historic structures and features would constitute direct evidence of high archaeological potential. In the absence of these findings, the possibility of locating subsurface evidence would be evaluated according to the proximity of the study area to areas of known historic activity.

The results of the sensitivity analysis indicated the area designated for inclusion in the Phase I study by the ACOE exhibited a moderate or high archaeological potential; while that portion of the project site considered by the ACOE to be devoid of significant cultural resources was, in fact, low in archaeological potential. High and moderate potential areas were so designated on the basis of either archaeological materials having been located in or near the project area, or by the presence of topographic features associated with high site frequencies elsewhere in New England. With the exception of the proposed Mall Drive, all transportation improvement areas were considered to have a low archaeological potential.

Recent studies in the lowlands (McBride, 1979) and adjacent highlands (Wadleigh, 1979) of the Connecticut River Valley, and in the coastal plain of Rhode Island (McBride, 1979) indicate that pit placement every 20 meters is necessary to locate sites of low artifact density. Thus, the high and moderate sensitivity areas were sampled by excavating 40 cm square test units at 20 meter intervals. Additional test units, or supplementary 4 in. cores were placed in those instances when initial test units indicated a possibility of prehistoric or historic remains, and additional testing was required to confirm or deny initial results. Supplemental 4 in. diameter soil cores were also placed in order to assess past disturbance of deposits in the project area and to locate cultural resources in any undisturbed deposits overlain by fill.

All backdirt was screened through 1/4 in. mesh screens. The walls of each test pit were examined for anomalies (i.e. charcoal fragments or stains, etc.), as indicators of prehistoric activity.

Twenty-seven transects were placed north/south across the study area at 20 meter (60 ft) intervals (See Figure 1). One east/west transect was placed along the proposed Mall Drive from Valley Service Road to the railroad tracks. Along these transects, test pits were excavated at 20 meter intervals based on the criteria discussed above. Additional test pits were placed in areas considered to have a high potential for prehistoric activity. As a result, this systematic survey allowed equal coverage of all sections of the study area.

2.2 Results

2.2.1 Known Prehistoric Sites

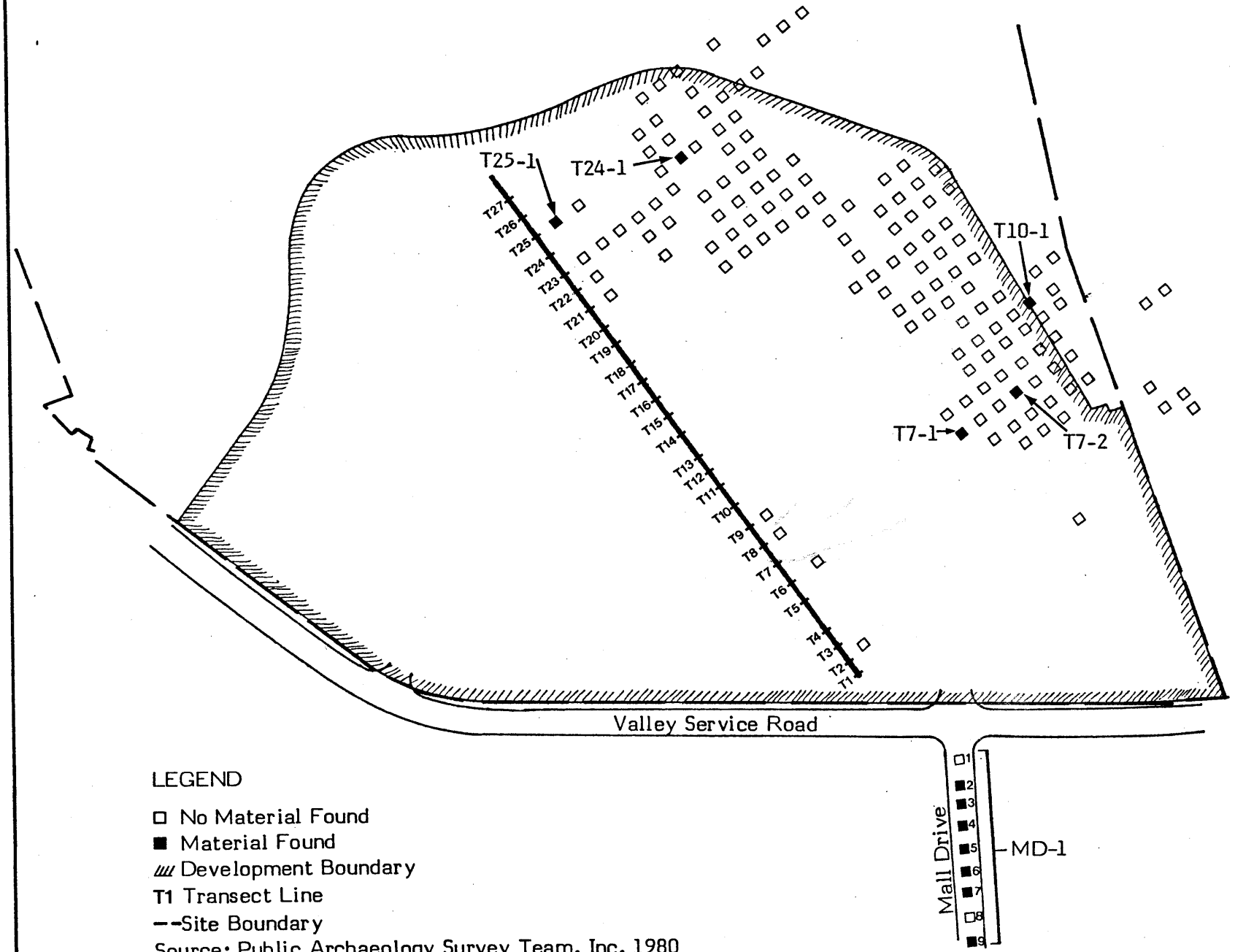
Nineteen reported prehistoric sites are located within a mile of the project site. Information regarding these sites is on file in the office of the Connecticut Historical Commission.

A case for contemporaneity can be made for several of these sites based upon projectile point typology and comparisons of lithic assemblages. Projectile points related to the Laurentian Tradition (5,000 to 4,000 Before Present (BP)) have been identified at eight sites. Components related to the Small-Stemmed Tradition (4,500 to 3,500 BP) have been identified at thirteen of the sites. Susquehanna and Orient Phase components have been identified at three of the sites. In addition, various Woodland Period occupations have been identified at as many as four of the reported sites.

The occurrence of several contemporary assemblages in a variety of environmental contexts suggests that the North Haven area was heavily utilized by prehistoric populations for a variety of purposes. The various sizes of these reported sites, as well as their locations adjacent to the Quinnipiac River and several smaller streams, suggests that these sites were most likely being used for different purposes. It is unclear at this time whether these sites represent seasonal coastal occupations by groups usually living further inland, or if the inland and coastal areas of Connecticut supported separate permanent settlement-subsistence systems. The general area has been occupied from at least 4,500 BP through the late Woodland period (1,000 + BP). The number of sites located during Phase I investigations supplements the State's inventory. (See Attachment C for a discussion of the region's prehistory and history).

2.2.2 Project Site

Five prehistoric sites were located during Phase I investigations (See Figure 1). In some instances, additional test units were required to confirm the presence of a site. Table I presents the findings of the Phase I investigations and a description of each site.



LEGEND

- □ No Material Found
- ■ Material Found
- /// Development Boundary
- T1 Transect Line
- --Site Boundary

Source: Public Archaeology Survey Team, Inc. 1980

FIGURE 1

NORTH HAVEN MALL
North Haven, Connecticut

0 200′ 400′

Location of Study Area Transects

JASON M. CORTELL and ASSOCIATES INC.

Table I

PHASE I RECONNAISSANCE RESULTS
North Haven, CT

	T7-1	T10-1	T24-1	T25-1	MD-1
Location	Approximately 200 meters west of Valley Service Road, 300 meters north of drainage ditch, and 400 meters east of the Quinnipiac River. Pits T7-P10 and T7-P13.	Approximately 300 meters west of Valley Service Road, 300 meters north of drainage ditch, and 260 meters east of the Quinnipiac River. Pit T10-P16.	Approximately 550 meters west of Valley Service Road, 50 meters east of Quinnipiac River, 175 meters north of drainage ditch. Pit T24-P7.	Approximately 300 meters west of Valley Service Road, 250 meters north of drainage ditch, 250 meters east of Quinnipiac River. Surface finds - T24-P5 area.	20 meters east of Valley Service Road along Mall Drive to railroad tracks.
Size	Unknown - Remains recovered over a 60 x 60 meter area.	Unknown	Unknown	Unknown	Unknown - at least 180 meters by 20 meters.
Environmental Setting	A well-drained terrace that runs east-west. Surrounding area is very poorly drained. Quinnipiac River, only water source in immediate area.	A well-drained terrace that runs east-west. Surrounding area is poorly drained.	Poorly-drained terrace overlooking the Quinnipiac River; adjacent to small brook emptying into the Quinnipiac River.	Terrace overlooking the Quinnipiac River.	Terrace overlooking the Quinnipiac River.
Site Integrity	Good. Recovered remains from plow zone; little or no additional disturbance present. Information on size, density, age, and function still obtainable.	Good. Recovered material from plow zone; little or no additional disturbance present. Information on size, density, age, and function still obtainable.	Good. Recovered material from plow zone; no additional disturbance noted. Information on size, density, age, and function still obtainable.	Poor. Construction of drainage ditch, adjacent overflow pond destroyed most of this site.	Good to excellent.
Period	Prehistoric - unknown, suspected Archaic Period.	Prehistoric - unknown period.	Prehistoric - unknown period.	Prehistoric - unknown period.	Prehistoric -Woodland
Stratigraphy	All material recovered from plow zone. Possibility of intact features.	All material recovered from plow zone. Possibility of intact features.	All material recovered from plow zone. Possiblity of intact features.	None noted.	Eastern portion appears undisturbed.
Recovered Data	Chert flakes, one drill. See Artifact Inventory List.	Quartz flakes. See Artifact Inventory List.	Flint, basalt, and quartz. See Artifact Inventory List.	Flint and quartz flakes. See Artifact Inventory List.	1 biface fragment; 1 flint flake; 3 unutilized flakes; 3 quartz flakes.
Features	None observed.	None observed.	None observed.	None observed.	None observed.

All recovered materials are presently located in the Laboratory of Archaeology, University of Connecticut.

2.3 Analysis

Phase I archaeological investigations within the North Haven Mall study area resulted in the location of five prehistoric sites. Four of these prehistoric sites were located on the proposed mall site; an additional prehistoric site was located along the proposed Mall Drive. No sites were found in the areas of the proposed jughandle off Route 5/22 or the proposed widening of Valley Service Road.

By applying the Criteria of Effect and Adverse Effect (36 CFR 800.3), it was determined that four of the five sites may be adversely affected by the construction of the North Haven Mall. Thus, a Phase II investigation was performed on the remaining four prehistoric sites in the project area (T7-1, T10-1, T24-1, MD-1). One prehistoric site (T25-1) will not be adversely affected by construction activities as this site has been disturbed by previous construction and quarrying activities in the area and is, therefore, limited in archaeological potential.

3.0 PHASE II ARCHAEOLOGICAL INVESTIGATIONS

3.1 Methodology

3.1.1 Archaeological Sites

The Phase I Reconnaissance Survey of the North Haven Mall study area resulted in the identification of five prehistoric sites. Four of these sites (T7-1, T10-1, T24-1, and MD-1) were determined to require additional testing and evaluation in the form of Phase II intensive surveys. In the course of the Phase II investigations, Site T7-1 was discovered to consist of two separate sites, which were labeled Sites T7-1 and T7-2 (See Figure 1).

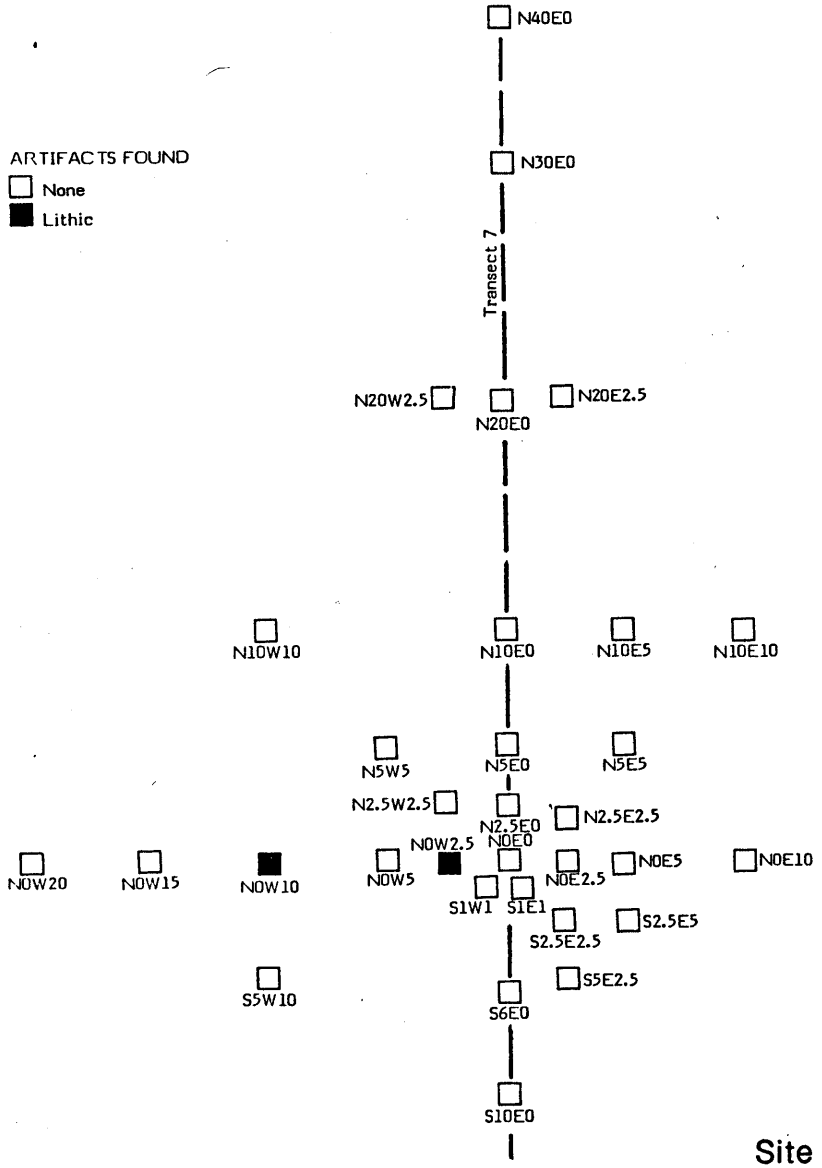
Previous research in Connecticut has attempted to examine the total range of sites comprising a subsistence-settlement system. From this perspective, small, special-purpose, limited activity or seasonal camp sites such as T7-1, T7-2, T10-1, T24-1, and MD-1 add to the available information as do well-stratified, large village sites which are frequently found along the coast. Data collection with such an orientation enables the archaeologist to define specific tool kits and activity areas within and between sites.

A method was developed to place these sites within the context of the New Haven/North Haven area, and/or within the broader context of Southern New England prehistory. The site sampling design employed in the investigations of these five sites is a variation of a design used by Chartkoff (1978), known as transect interval sampling. This method involves the excavation of a series of radially patterned test pits originating from the perceived center of the site or the initial find spot. These radially patterned transects also correspond to a standard grid system. For example, the northeast transect would include N5E5, N10E10, and N15E15, etc.

This design determines the size, integrity, and density of the site, as well as yielding a representative sample of the material remains.

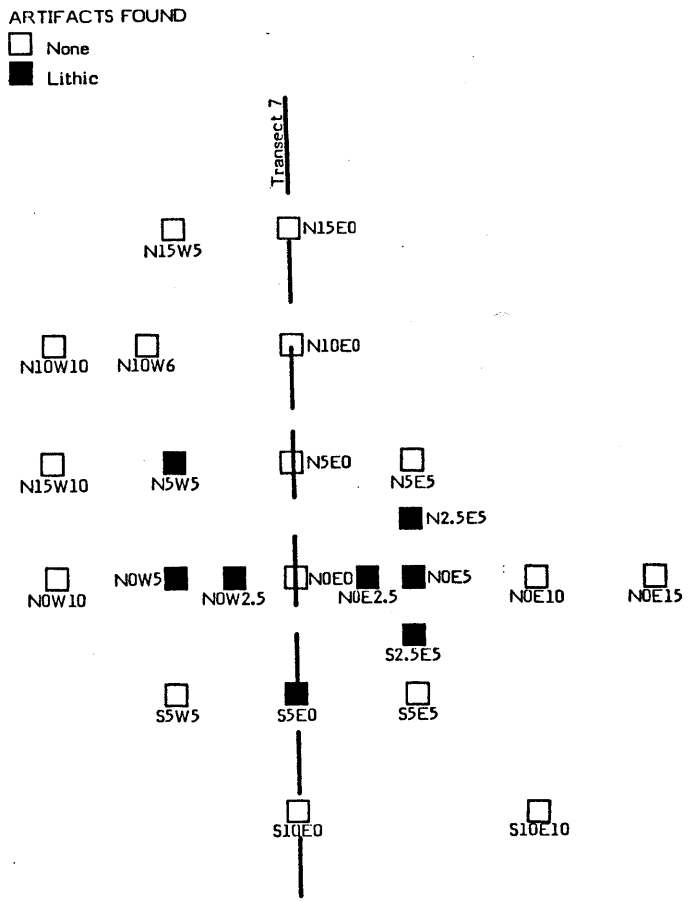
3.1.1.1 Site T7-1 (Figure 2)

Eight transects were established extending outward from pit T7P10 (NOEO), running north-south, east-west, northeast-southwest, and northwest-southeast. Since the original transect ran approximately north-south at this point, Phase I investigations had essentially sampled most of the north transect. Along the eight transects, test pits were excavated at 5 meter intervals. When no cultural material was recovered in two successive test pits, the first was considered to be the site's boundary. Thirty-two test pits were excavated in this area. All test pits were 50 cm square, and were excavated to a depth of one meter. All material was filtered through a 1/4 in. mesh screen. Artifacts were bagged and identified in 5 cm (2 in.) levels. Based on the information obtained during Phase II investigations, the total area of the site is less than 30 m^2 (900 ft^2).



Site T7-1
FIGURE 2

Source: Public Archaeology Survey Team, Inc. 1980



Site T7-2
FIGURE 3

Source: Public Archaeology Survey Team, Inc. 1980

NORTH HAVEN MALL
North Haven, Connecticut

0 5 10m

Location of Transects: Sites T7-1 and T7-2

JASON M. CORTELL and ASSOCIATES INC.

3.1.1.2 Site T7-2 (Figure 3)

As originally defined after Phase I investigations, this site covered an area between T7P10 and T7P13. A design similar to that used for T7-1 was employed on this site. Twenty-four test pits were excavated (in addition to those excavated during Phase I investigations). Ten of these pits yielded prehistoric cultural material. The investigations indicated that the boundaries of Site T7-1, as originally defined in Phase I investigations, were overestimated since material remains did not extend continuously within the area between T7P10 and T7-13. As a result, it was determined that there were two distinct loci of activity, T7-1 and T7-2.

3.1.1.3 Site T10-1 (Figure 4)

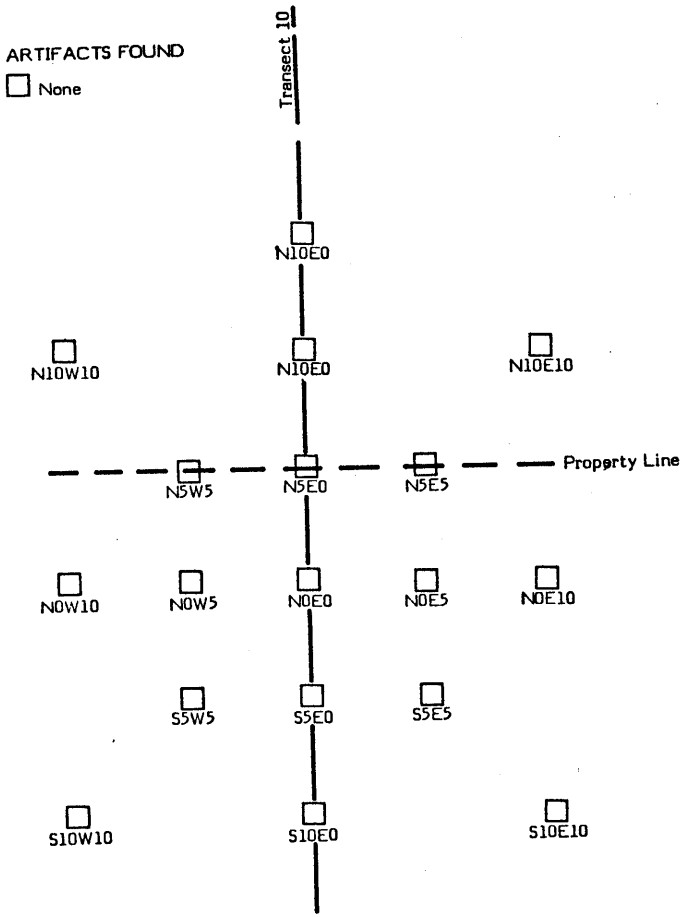
A total of 18 test pits were excavated at Site T10-1 in a pattern similar to that employed on the other three sites. Two unutilized quartz flakes had been recovered during Phase I investigations, but no artifactual material was found during the Phase II survey.

3.1.1.4 Site T24-1 (Figure 5)

A similar sampling design was used for Site T24-1. Twenty-four test pits were excavated. Twenty-one of these pits were placed to the east and southeast of Transect 24 because virtually impenetrable briars prevented the excavation of more test pits to the west of the transect. Eleven of these twenty-one test pits yielded cultural material. The three test pits placed to the west and southwest of Transect 24 on this site yielded no cultural material. Based on testing conducted to date, the site has an estimated area of 500 m^2. It is possible that the western boundary of this site may extend beyond the area indicated by the test pits excavated to date (see Section 4.0). Based on the Phase II testing, topographic features in the immediate area, and the general configuration of the eastern portion of the site, however, it is likely that the maximum size of Site T24-1 does not exceed 3,000m^2.

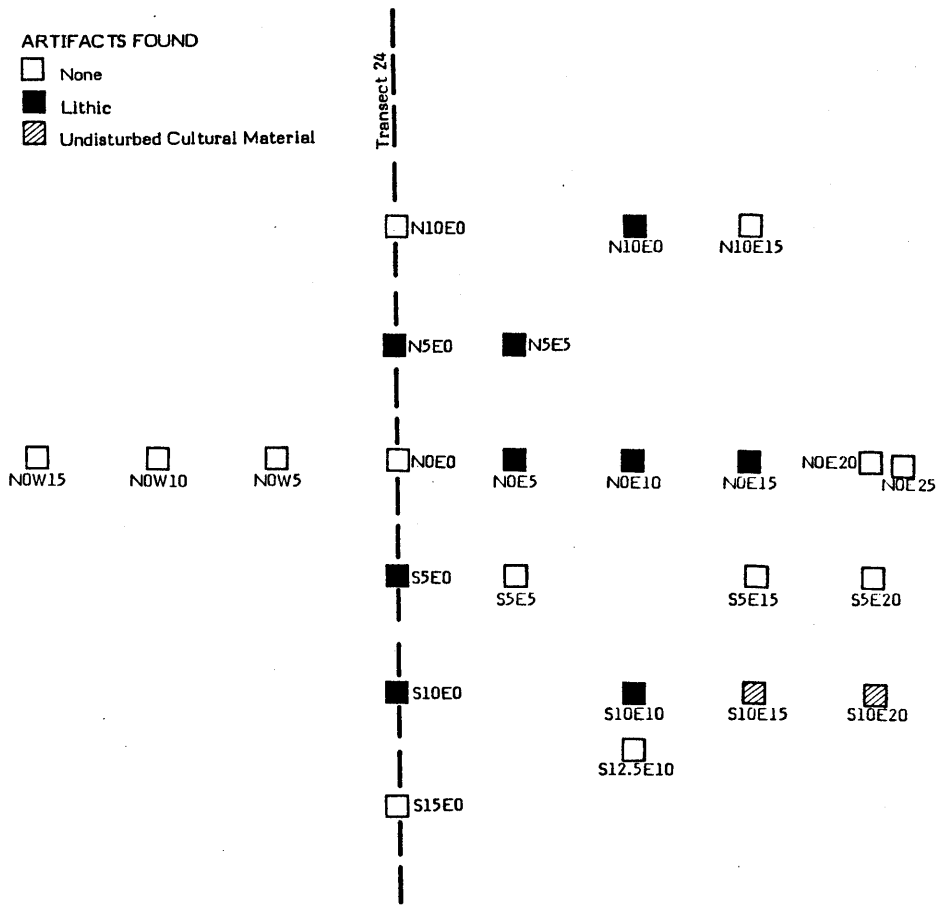
3.1.1.5 Site MD-1 (Figure 6)

A centerline was laid east-west along the proposed Mall Drive to Valley Service Road and a grid system established from this centerline. Forty-seven test pits were excavated in the same way as the other sites. Eleven of the test pits yielded prehistoric cultural material. All but one of the remaining test pits yielded historic material. A discussion of the historic material is presented in Section 3.2.5. Based upon this testing, the site appears to measure approximately 5000 m^2.



Site T10-1
FIGURE 4

Source: Public Archaeology Survey Team, Inc. 1980



Site T24-1
FIGURE 5

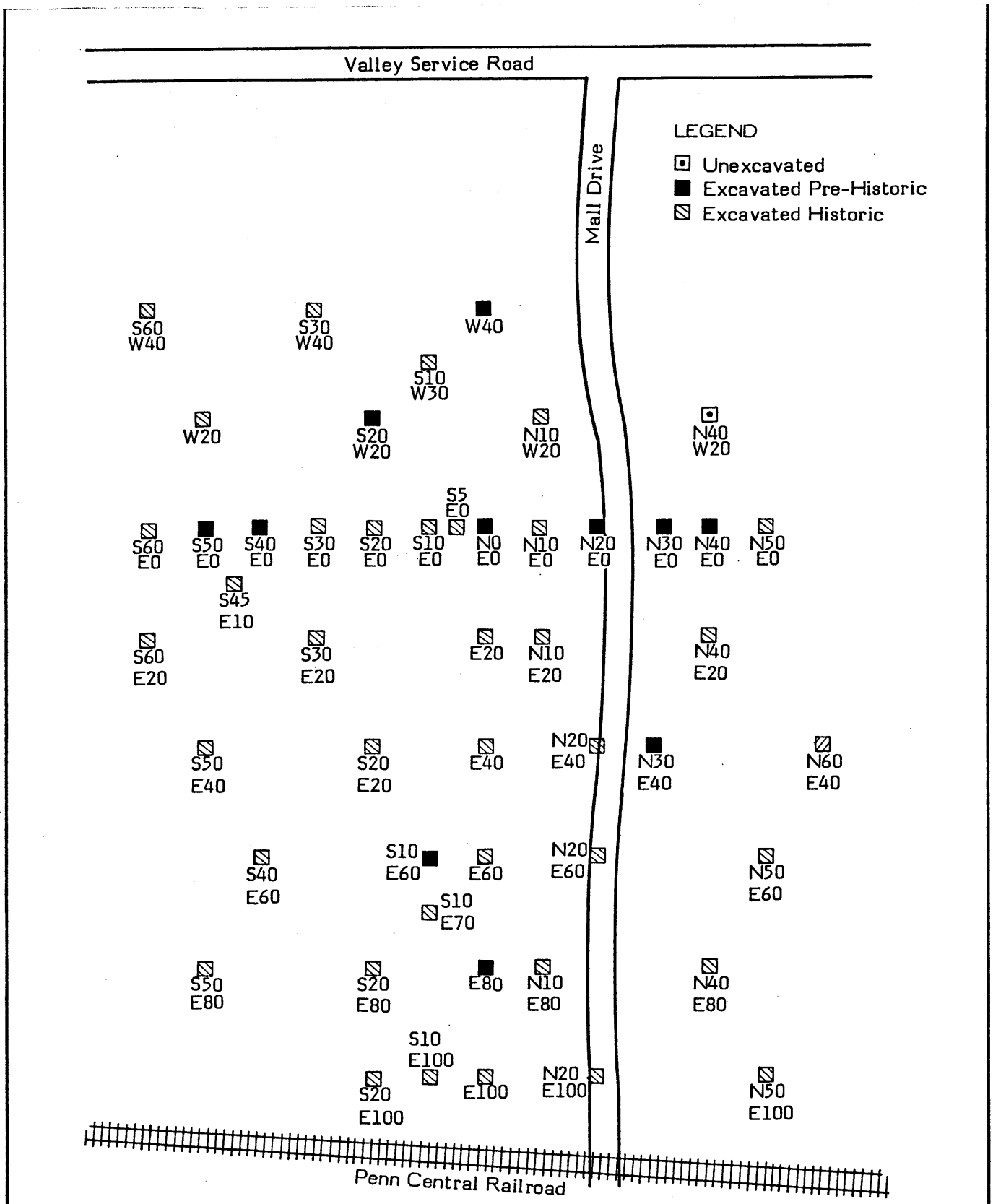
Source: Public Archaeology Survey Team, Inc. 1980

NORTH HAVEN MALL
North Haven, Connecticut

0 5 10m

Location of Transects: Sites T10-1 and T24-1

JASON M. CORTELL and ASSOCIATES INC.



Source: Public Archaeology Survey Team, Inc. 1980

FIGURE 6

NORTH HAVEN MALL
North Haven, Connecticut

Location of Transects: Site MD-1

0 - 10 20m

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3.1.2 Lithic Artifacts

Most studies suggest that the only data pertinent to archaeological interpretation consist of actual tools, such as projectile points (arrowheads), knives, etc. However, the most common items found in virtually all lithic (stone) assemblages are the so-called unutilized lithic flakes and debitage. The standard treatment of lithic debris and unretouched flakes has been simply to enumerate them.

Lithic debitage has the potential for providing a great deal of information concerning a number of processes which affect the interpretation of a particular site. For example, when an edge is utilized and is then re-sharpened, the evidence of that utilization is distributed among hundreds of pieces of debitage. A significant portion of the debitage at any given site may retain evidence of past utilization episodes (Frison, 1968; DelBene, 1976). The debitage may also contain information concerning manufacture and other technological processes. Collectively, debitage contains the majority of information concerning manufacture, as compared to form tools. If the retouching of form tools has been extensive enough, all of the information concerning the earlier stages of manufacture are removed. In these instances, the information can only be provided by an analysis of the debitage.

The current emphasis in New England on regional studies and cultural resource management-related research has resulted in the location of a substantial number of low-density and special-purpose prehistoric sites. The vast majority of these sites lack datable materials, and most lack those items which are currently time-stratigraphic markers. One of the best ways to interpret these sites, then, is in terms of the associated technology. This study focuses primarily on the utilizational subsystem, but also includes some information concerning the manufacture subsystem. Together, these two subsystems provide a detailed description of the technology of the sites under investigation. While each site is unique, general similarities for the purposes of comparison exist.

Site function is critical to archaeological interpretations, particularly on a regional scale. In general, site function is inferred by the presence of relatively obvious features or in terms of some other feature near the site. For example, sites located adjacent to rivers may be labeled fishing camps; those located on hills may be labeled lookouts or defensive positions. In these instances, the environmental features play a greater role in the determination of site function than the lithic remains from the sites.

In terms of the interpretation of low-density sites, the assemblage of artifacts from a site plays a stronger role in determining site function than locational characteristics, for example. The function of the site would be the result of the sum of the activities which transpired there. However, since the amount of debris from different activities does not have a one-to-one correlation with the amount of activity, a certain degree of caution is necessary in the interpretation of the different percentages of tools.

The question then arises as to how the different aspects of each assemblage can be separated for analysis and interpretation. A number of approaches have been used, with varying degrees of success. The most common is the typological-methodological approach. This approach assumes that implements with similar morphologies shared similar roles in the utilization technology. The functions assigned to items usually mirror known ethnographic uses for similar items. However, this system does not account for any variations between the known ethnographic record and the prehistoric record. Thus, it is useful for descriptive purposes, but is inadequate for the interpretation of prehistoric processes of technology.

The most useful technique for describing functional classes of artifacts is the analysis of use-wear features, since it is capable of examining by-products of the utilization process. This approach is hampered by the fact that the early stages of utilization are often obscured by later ones. In addition, there are a number of other processes which produce damage closely resembling utilization related damages (Logsdon, 1976). However, while these factors complicate the interpretation of use-wear and damage, use-wear analysis offers the best method with which to study prehistoric utilization processes.

There are a number of techniques of use-wear analysis, differing mainly in the levels of observation used. Some feel that damage traces observed at 10 diameters of magnification or less are adequate (Dunnel and Whitlam, 1977; Holley, 1979). Other investigators favor microscopic examination between 20 and 100 diameters (Odell and Vereekian, 1980; DelBene, 1976). Another approach suggests that the valid interpretation of use-wear requires magnifications in excess of 100 diameters (Keeley, 1980). In general, the higher the level of magnification, the more specific one can be about the functions of the items examined. The disagreement over levels of magnification is primarily due to the differing goals of the scholars involved.

The use-wear analysis technique employed for this study is the low magnification system proposed by Dunnel and Whitlam (1977). This technique is most applicable for the interpretation of site function, and has certain advantages:

1. It is comparatively simple to use, and can be employed by individuals with little background in lithic technology. The simplicity of the system also insures similar results by different individuals.

2. The system is very time-and cost-efficient. The higher levels of magnification require time consuming microscopic examination in addition to more equipment and training of personnel.

The classification system used in this study was adapted from Dunnel and Whitlam (1977). In addition to the basic use-wear/damage attributes of Dunnel and Whitlam, a series of other technologically relevant characteristics were added. The system is as follows:

Code #	Attribute
	Kind of Material
1	quartz
2	quartzite
3	cryptocrystalline
4	volcanic
9	other
	Kind of Object
1	flake
2	chunk
3	core
4	cobble/pebble
5	formed
9	other
	State of Object
1	whole
2	fire-cracked
3	fragment
4	shatter
9	other
	Kind of Wear
1	nicked
2	chipped (feather termination predominant)
3	chipped (step/hinge termination predominant)
4	crushed
5	polished
6	abraded
7	striated
9	other
	Location of Wear
1	edge (unmodified)
2	unifacial edge
3	bifacial edge
4	edge to a point
5	point
6	surface
9	other
	Plane of Wear
1	convex
2	concave
3	straight
4	sinuous
5	projection
6	notch
9	other

Orientation of Wear

1 parallel
2 oblique
3 perpendicular
9 other

Edge Angle

1 low (0 - 30 degrees)
2 medium (31 - 60 degrees)
3 high (61 - 90 degrees)
4 obtuse (greater than 90 degrees)

Flakes

1 whole
2 fragments

Kind of Flakes

1 biface reduction
2 re-sharpening
3 blade
4 amorphous

Form Tools

1 drill
2 biface

The low magnification system employed here allowed for the collection and analysis of data in an efficient fashion. All use-wear and damage was observed with a hand lens at 10 diameters magnification.

3.2 Results

The subsequent sections present the results of the Phase II study. Tables 1 through 6 in Attachment D list the items recovered from each archaeological site.

3.2.1 Site T7-1

Site T7-1 yielded two lithic items during Phase I and II investigations, both of which show use-wear consistent with what is normally defined as a "drill" (see Attachment E, Plates I and II). One of the drills, recovered from Pit T7P10, is of basalt and exhibits use-wear in three areas: point, edge, and surface. This use-wear is most apparent as a polish, which occurs after extended use of the item. The second drill is of quartz. This item has been retouched on one face and exhibits evidence of use-wear and damage on both edges. No evidence of tool manufacture or maintenance was recovered with these artifacts. It is not known what material or materials these tools were being used on, but the polish on one of the drills appears to have been the result of use on a relatively soft substance.

All recovered cultural material was confined to the plow zone; no evidence was recovered that would indicate an intact or undisturbed cultural zone. A number of fire-cracked rocks were recovered, but it is not possible to determine if these items were broken by natural or artificial means (such as in a camp fire).

Site T7-1 is clearly a small special-purpose site. The two items recovered suggest some kind of activity associated with the drilling implements, the nature of which is not clear.

The total site area is less than 30 m^2, with an extremely low density based on the two items recovered in the area. Due to the limited data recovered from Site T7-1, it is impossible to assign a date or cultural affiliation to this site. It is unlikely that this information is present at the site based on the limited extent of recovered material; thus, no additional investigations are recommended.

3.2.2 Site T7-2

Site T7-2 yielded 141 lithic items: 139 flakes and two form tool fragments. All of the items are of chert (see Attachment E, Plates II and V) with the exception of one quartz flake. Three of the flakes show evidence of use-wear; more specifically, chipping with feather termination. The Site T7-2 flakes also include three biface reduction flakes, one of which exhibits evidence of use-wear (see Attachment E, Plate IV). In addition to the relatively large quantity of flakes, two biface fragments were also recovered from this site (see Attachment E, Plate III).

No evidence was recovered from this site to indicate age or cultural affiliation. The majority of the recovered material was from below the plow zone. Consequently, this site is essentially intact and undisturbed, and the chances of recovering an intact datable feature are high. The total site area of T7-2 is approximately 150 m^2.

Like Site T7-1, Site T7-2 appears to represent a special-purpose or limited activity site, but with a wider range of activities. Analysis of the lithic assemblage from this site indicates that Site T7-2 served primarily as a locale for the manufacture and maintenance of stone tools, probably bifaces, with a small number of ancillary activities also taking place.

It is likely that T7-2 and the other sites within the North Haven Mall study area are associated with other larger sites located within the Quinnipiac River valley or along the coast. Site T7-2 presents an opportunity to study a limited activity site within the context of a larger prehistoric settlement-subsistence system. The site is undisturbed; thus, the possibility of recovering an intact feature for radiocarbon dating is considered very good. Through radiocarbon dating, the site and its associated activities can be connected with other contemporary sites in the area. This kind of information can aid in the reconstruction of the prehistoric subsistence-settlement system in the area. Therefore, additional investigations are recommended (See Section 4.0).

3.2.3 Site T10-1

The recovery of two unutilized flakes from this site would indicate that some activity (probably manufacturing) had taken place in the immediate area, but the information recovered does not allow for substantive conclusions. Like Site T7-1, this site represents a limited activity or special-purpose site of extremely low density. It is unlikely that additional excavations will recover any other cultural material.

As no diagnostic material was recovered, it is difficult to place this site within the broader context of the area's subsistence-settlement system. However, it does represent a locus of human activity, and the information recovered can be useful for developing predictive models of site location for planning purposes. Unlike Site T7-1, the remains were recovered from below the plow zone. Nonetheless, due to the limited extent of recovered material, it is unlikely that additional remains would be recovered with further investigations. Therefore, no such investigations are recommended.

3.2.4 Site T24-1

Twenty-six lithic items were recovered from this site. The collection consists entirely of flakes (see Attachment E, Plate IX); no bifaces or form tools were recovered. Approximately 50 percent of the flakes are of flint/chert, 25 percent are of quartz, and 25 percent are of slate. All but four of the flakes are unutilized. The four items which have been utilized show different types of use-wear. One of these items, a chert flake, reveals evidence of two kinds of wear; one probably the result of hafting (the fitting of an item to a handle), the other the result of the utilization of the point of the flake (see Attachment E, Plate VIII). The other three utilized flakes are of flint; two of which show use-wear on a straight edge and one on a convex edge (see Attachment E, Plate VII).

No evidence was recovered from this site to indicate either age or cultural affiliation. One feature was observed that could possibly provide suitable organic material for a radiocarbon date. A cultural layer consisting of charcoal and burnt bone was encountered between 45 and 55 cm (17 to 22 inches) below the surface (see Attachment E, Plate VI). In addition to the organic material, 26 flakes were recovered.

Analysis of the lithic assemblage indicates that the major activity occurring at this site consisted of the manufacture of stone tools, with some ancillary tasks being performed. The relatively high percentage of utilized flakes (as compared with T7-2), taken with the presence of the cultural layer of burnt bone and charcoal, would suggest that some subsistence activities also occurred at this site. The extraction of organic material from this cultural level could provide information on the age of the site as well as on the season and the mode of subsistence.

Few sites of this type have been reported or excavated, and very little information has been collected concerning the relationship of these smaller resource or task-specific sites to the large villages generally located along the coast or along the larger rivers and streams. Site T24-1 most likely represents a temporary camp for the exploitation of seasonal or specific resources associated with the Quinnipiac River. Based on the material recovered from this site, additional investigations are recommended (See Section 4.0).

3.2.5 Site MD-1

This site yielded 20 lithic items. The collection consists of one utilized chert uniface (scraper), one quartz chunk, and 18 unutilized flakes. Nine of the flakes are of quartz, 5 are of slate, 2 of flint, 1 of chert, and 1 of quartzite. In addition to the lithic items, 3 sherds of aboriginal pottery were recovered.

Two of the recovered items (the uniface and a flake) are of chert. The chert appears to be the same material as that recovered from Site T7-2. There are no known sources of chert in southern New England; thus it is possible that the same group of people occupied both sites, but in different seasons and/or in different years. The basis for assuming the potential seasonality of occupation is due to the nature of the recovered material. It is possible, for example, that subsequent to abandoning one of the sites, the same group of people returned to the general area previously occupied and established another site.

Site MD-1 appears to represent a special-purpose or limited activity. Analysis of the lithic assemblage and pottery fragments recovered from this site indicates that MD-1 served primarily as a center for the manufacture and maintenance of stone tools, with some ancillary activities also taking place.

Unlike Sites T7-1, T7-2, and T24-1, evidence was recovered from this site that would indicate age or cultural affiliation. The presence of pottery places the site at least in the Woodland Period. Moreover, the majority of the recovered material was from below the plow zone; thus, this site is essentially intact and undisturbed. As a result, the chances of recovering an intact datable feature are good. The total site area of MD-1 is approximately 5000 m^2.

All historic material recovered from Site MD-1 included late 20th century items. These items primarily consisted of cans, bottles, bottle caps, and glass fragments. No material of historic significance was recovered from the site.

In sum, Sites T7-2, T24-1, and MD-1, as with numerous other archaeological sites in the area, add to the understanding of the prehistory of both the Quinnipiac River drainage area and of Southern New England. These sites are important, particularly within the context of other sites reported or currently being studied in the area. Thus, additional investigations are recommended (See Section 4.0).

3.3 Analysis

Phase II investigations were conducted to collect the information necessary to assess Sites T7-1, T7-2, T10-1, T24-1, and MD-1 with respect to eligibility criteria for nomination to the National Register of Historic Places. These criteria, as stated in 36 CFR 60, are provided in Section 1.2. The only potentially relevant criterion is Subsection d. ". . . that have yielded, or may be likely to yield, information important in prehistory or history."

It is the opinion of the Survey Team that, similar to other known sites in the vicinity of the project area, Sites T7-2, T24-1, and MD-1 may be eligible for nomination to the National Register. In contrast, Sites T7-1 and T10-1 do not appear to be eligible for nomination. This is primarily due to their relatively small size and the limited likelihood of recovering additional information from these sites.

Regarding the potentially eligible sites, information to indicate age or cultural affiliation was only recovered from Site MD-1. However, the boundaries and approximate size of each site have been determined, and the integrity of the sites has been assessed. The sites are not disturbed; all of the cultural materials were recovered within the primary context of the sites. Thus, the integrity of each site is good. Moreover, Sites T7-2, T24-1, and MD-1 have the potential to provide significant information about local and regional (Southern New England) prehistoric lifeways, particularly subsistence and settlement patterns. Small special-purpose sites such as these can be as informative as large village sites, and relatively few have been studied.

3.4 Cumulative Impacts

Cumulative impacts may occur from secondary development resulting from the construction and operation of the North Haven Mall. According to Gladstone Associates (Economic and Land Use Impacts of the North Haven Mall, 1981), secondary commercial development is most likely to occur along Washington Avenue and the east side of Valley Service Road. Any additional office space, however, is likely to occur only along the east side of Valley Service Road.

Commercial growth along Washington Avenue will probably be limited to the expansion of existing community shopping facilities and the more efficient utilization of existing space. Along the east side of Valley Service Road, secondary commercial and office development is most likely to occur opposite and south of the project area between the North Haven Mall and Route 5/22. It should be noted, however, that office space is projected to occur in either one office building or as second-story office space above the retail establishments. Limited areas of moderate or high archaeological potential may occur along Washington Avenue and the east side of Valley Service Road. Thus, in the event of future development plans in these areas, it is recommended that appropriate aracheological investigations be conducted on these sites.

Residential development generated by the proposed project will be negligible. This is due to the likelihood of existing residential areas in the Town of North Haven supporting the estimated number of persons seeking residence in the Towns as a result of the proposed project (See Economic and Land Use Impacts of the North Haven Mall Report; Gladstone Associates, 1981). Thus, it is likely that archaeological resources will not be significantly affected by secondary residential development.

4.0 CONCLUSIONS

Based on the information collected during the Phase I and Phase II archaeological studies, it has been determined that, in the absence of mitigative measures, the proposed project may adversely affect three potentially eligible sites (T7-2, T24-1, and MD-1) to the National Register. This determination is based on the Criteria of Adverse Effect, as stated in the Advisory Council Procedures for the Protection of Cultural Resources (36 CFR 800.3(b)).

Although each of the archaeological sites may be left undisturbed, incorporated into project design, and permanently fenced off, the potential nonetheless exists for construction-related impacts resulting from construction equipment and the process of placing fill adjacent to these areas. Alternatively, the sites may also be impacted by the direct placement of fill and parking facilities over these areas. Shallow archaeological sites are easily damaged and/or destroyed by the weight of the fill itself and the use of the heavy equipment to dump the fill (Wilson, 1975). The weight damages or destroys the artifacts, and may also compact the soil severely enough to result in the loss of stratigraphic data. In addition, the sites could be rendered unrecoverable because of the depth of the fill and the resulting landmark changes.

The Public Archaeology Survey Team, thus, recommends as an appropriate mitigative measure for Sites T7-2, T24-1, and MD-1 that a reasonable excavation plan be worked out with the Army Corps of Engineers, the Connecticut Historic Preservation Officer, and the Applicant. In addition to establishing the western boundary of Site T24-1, this plan should allow for a representative sample of archaeological remains to be obtained which would place these sites within the larger context of Southern New England prehistory.

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ATTACHMENT A

ARCHAEOLOGICAL RESEARCH DESIGN

The North Haven area constitutes a research field for New England prehistory. Data generated by the North Haven Mall project could elucidate issues of anthropological significance as well as aid in the conservation of archaeological information. In recent years, various authors have stated the importance of relating environmental impact surveys to the deductive, problem-oriented framework of archaeological research (Schiffer & House, 1977; McGimsey & Davis, 1977).

The Public Archaeology Survey Team defined its research objective as the explication of prehistoric adaptation and change through a regional, cultural-ecological approach (McBride, 1979). This objective is consistent with the requirements of the Army Corps of Engineers and the Connecticut Historic Preservation Officer. This model requires a representative sample of the temporal, spatial, and functional variability of archaeological sites within a particular region. The North Haven Mall project area is not a large enough area to provide the full range of sites found in a settlement-subsistence system. However, it does offer the opportunity to study several small special-purpose sites, which could contribute to information about the prehistoric settlement and subsistence system in the North Haven area.

In Phase II investigations, explicit attempts were made to insure the retrieval of data pertinent to the questions of cultural chronology, settlement patterns, economic adaptation, and cultural processes, by incorporating the research design into existing regional designs from other parts of Connecticut and New England. Current research in Connecticut (McBride, 1979; Wadleigh, 1979; McBride and Wadleigh, 1979; Feder, 1980) is attempting to document and study culture change from a regional and subregional perspective within the context of site placement and site type as a response to specific environmental variables. Research is conducted in such a manner that the total range of sites comprising a settlement system is examined. Data collection with such an orientation enables the archaeologist to define specific tool kits and activity areas within and between sites.

A basic assumption of this research approach is that the physical environment is structured, and that the culture being investigated is an adaptive system that interrelates very closely with the environment. Since plant and animal resources are differentially distributed, subsistence and settlement patterns can be expected to reflect these differences. Populations exploiting similar environments or resources will exhibit similarities in site assemblages and locations. For example, sites situated within the ecological zone of the coastal plain will most likely reflect the exploitation of different resources than sites situated inland along the Quinnipiac River or adjacent to marshes and swamps. Differences in form and function of contemporaneous sites between these different ecological zones exist as well as similarities between sites within each zone. An approach of this kind does not allow the archaeologist to simply define a typical site or assemblage. To reconstruct a settlement system (functional relationships between sites), it is necessary to conduct research within the context of a regional design.

The problem, therefore, is to identify the variability in artifacts, features, food remains, and site locations. One may then define several settlement "types" which together comprise the total system. Subsistence activities are distributed differentially within a geographic area; as a result, no single site or assemblage can be expected to reflect the entire range of seasonal subsistence activities. Once this range of variation has been systematically identified, more explicit processual models and hypotheses about adaptation and change can be constructed, and tested through further investigation.

Due to highly acidic soils and extensive plowing of the land, organic materials are very poorly preserved in New England. As a result, lithic remains play a major role in determining the range of activities at any given site, and a heavy emphasis was placed on the collection and analysis of lithic assemblages from those sites investigated during Phase II studies. The variation in frequency of tool types (form tools and utilized flakes) should reflect the activities associated with these tools. Lithic assemblages were examined for patterns of wear and damage on tool edges (See below). Eventually, subsistence systems can be reconstructed from the patterns of functional variability of tool assemblages of contemporaneous sites.

Given the stated objectives of this investigation, data retrieval procedures were designed for collection of the following classes of information from those sites investigated during Phase II studies.

1. Artifactual and/or other evidence of the temporal placement and cultural affiliation of the sites under investigation.

2. Carbonized wood and preserved organic remains from undisturbed stratigraphic associations with cultural deposits that would enable radiocarbon determination of site age.

3. Geomorphological associations which would relate site occupation to the known succession of geological events in the area.

4. Data on the surrounding environmental context which might reflect factors that influenced site location; specifically information on soils and natural vegetation, slope, proximity to water, and proximity to economic resources.

5. The spatial extent of material remains associated with a site to aid in functional and demographic interpretations.

6. A sufficient sample of artifacts and other material remains to suggest by their nature, frequency of occurrence and patterned associations, the kinds of activities carried out at the site.

7. Preserved floral or faunal remains which would permit the reconstruction of subsistence activities at the site.

ATTACHMENT B

PHYSICAL ENVIRONMENT

Refer to the following sources for information on the physical environment of the North Haven Mall area:

1. Appendix A - Geology and Groundwater Resources, Soils and Topography, North Haven Mall. Prepared by JASON M. CORTELL and ASSOCIATES INC., 1981.

2. Appendix B - Vegetation, Wildlife, and Wetlands, North Haven Mall. Prepared by JASON M. CORTELL and ASSOCIATES INC., 1981.

3. Appendix C - Surface Water Resources and Water Quality, North Haven Mall. Prepared by JASON M. CORTELL and ASSOCIATES INC., 1981.

ATTACHMENT C

REVIEW OF REGIONAL PREHISTORY AND HISTORY

The Paleo-Indian Period (14,000 - 10,000 BP)

The earliest archaeological evidence for human occupation in Southern New England dates from the end of the last glacial epoch, approximately 13,000 or 14,000 years ago. This so-called Paleo-Indian period has been circumscribed by the dating of distinctive fluted projectile points which have been recovered from as far north as Nova Scotia as well as from the southwestern and eastern United States. Unfortunately, few sites are well-preserved and much of the current knowledge of Paleo-Indian activities is based largely upon scattered surface finds of these points and associated stone implements. The use of stone indigenous to areas outside of New England indicates that long-range trading and/or social networks existed at this time. The archaeological data point to a low population density, with highly mobile bands of families hunting large game animals such as mastodon, mammoth, moose-elk, bison and caribou, and probably gathering plant resources. Virtually nothing is known of their social organization or of the nature of population movements into New England as glacial ice retreated.

The vegetation and climate of the late glacial and early post-glacial environment in Southern New England have been studied by many researchers through pollen analysis. Pollen profiles from several sites show remarkable consistency in the succession of plant communities. Summaries of local and regional findings have been published by Beetham and Niering (1^61), Sirken (1965), and Davis (1969).

Generally, glacial retreat was followed by a cold, dry tundra or park-tundra environment as indicated by pollen spectra of fir, spruce, pine, birch, and non-arboreal species such as sedges, grasses and herbs. In Southern New England, this succession is dated between 13,500 and 12,400 BP (Funk, 1972:9). Following this initial period, an increasing percentage of conifers, particularly spruce, provides evidence for a moister climate. It has been estimated that sea level was as much as 100 ft lower than today, and that the Southern New England coastline may have extended approximately 20 to 30 miles south and east of its present position. It is considered likely that many of the earliest coastal sites have been inundated by the subsequent rise in sea level (Salwen 1975:43).

Aside from finds of fluted projectile points from (present) coastal New York and Connecticut (Ritchie, 1969a, 1969b; Salwen, 1975), Paleo-Indian points have also been recovered from Glastonbury and Washington, Connecticut.

The Archaic Period (10,000 - 3,000 BP)

Subsequent to the Spruce Maximum c. 10,500 BP, increases in pine pollen indicate a trend toward warmer and drier climate conditions. While archaeological evidence is only slightly improved, a change in artifact styles, and in type and distribution of sites marks this as the beginning of the Early Archaic period (c. 10,000 - 8,500 BP). Sea level at this time was approximately 80 ft below its present level. Pollen spectra are characteristic of a more closed forest, which along the coastal zone, contained larger percentages of hardwoods in a patchy configuration (Salwen 1975:49). Gradually, an Oak-Hemlock forest was established and reached its climax c. 7,000 BP. Hunting and gathering continued, but larger Pleistocene fauna were gradually disappearing in favor of modern mammals such as elk, moose, beaver, bear, and deer; plant resources were also probably more abundant.

Several Early Archaic projectile points have been discovered in Connecticut. Although the change in plant and animal species undoubtedly had an impact on hunting and gathering activities of Early Archaic populations, concomitant changes in demography and social organization are as yet poorly understood. The increase in the number of sites known from this period may be indicative of a higher population density, but may also be due to factors of preservation, the nature of Early Archaic activities, or both.

The Middle Archaic (c. 8500-5500 BP), was marked by the beginning of a moister, warmer climate with an associated Oak-Hickory forest. Sea level was still rising, and shell middens in the lower Hudson Basin attest to the earliest known exploitation of marine molluscs such as oysters. Site locations and further changes in artifact types and styles attest to cultural changes and perhaps some diversification of diet, but fewer sites are known from this period. Middle Archaic projectile points have been found in the Connecticut River Valley and in the coastal areas of Connecticut. The Late Archaic period (c. 5500-3000 BP) was characterized by numerous changes, including a substantial increase in population density. The large numbers and varying locations of sites, in addition to the wide range and type of activities inferred from archaeological data, suggest that Late Archaic peoples practiced a very diversified seasonal pattern of plant and animal exploitation. There is evidence for subregional cultural differentiation as well as well-established trading networks for raw material. Projectile point types and tool kits are numerous, and appear to fall within three cultural "traditions", known as Laurentian, Susquehanna, and Small-Stemmed. Little is known about the meaning and relationship of these stone tool types to the social and economic organization during this period, but a "central-based wandering" pattern, utilizing a broad spectrum of resources has been hypothesized (Dincauze, 1975; McBride, 1979). This period has also produced clear evidence for elaborate burial practices.

Climatic conditions at this time were warmer than today, somewhat analogous to modern day Chesapeake Bay (Salwen 1975:51). Sea level was approximately 9 ft lower than at present (Salwen, 1975:49). Coastal sites are plentiful, especially in Connecticut (Glynn, 1963; Bourn, 1972; Sargent, 1952; Salwen, 1975). Several late Archaic occupations have been noted in North Haven. The files of the Connecticut Historical Commission list 15 Archaic sites in the town, several within 2 kilometers (one mile) of the project area.

The Woodland Period (3000 BP - Contact: circa 1600)

The Woodland Period, beginning some 3000 years ago, is defined on the basis of the first appearance of clay pottery. Since clay vessels are fragile and not easy to transport, their presence is usually taken to indicate a sedentary or at least semi-sedentary existence. Clay pottery is also generally associated with horticulture, but pottery appears in the Hudson Bay area approximately 3000 years ago, while the earliest unequivocal evidence for plant cultivation has been dated approximately 2000 years later (Salwen, 1975:55).

By 3000 BP, the climate in Southern New England was much like today, with some minor fluctuations. Sea level continued to rise at a slower rate of approximately 3 ft per millenium (Ibid.).

Remains of archaeological features characteristic of villages become increasingly prevalent during this period, especially after the spread of plant (maize, beans, squash) cultivation, for which the earliest definite date is c. 1000 AD in New York (Ritchie, 1969a). Villages were located on the coastal lowlands as well as along the major rivers and interior uplands.

The later Woodland subsistence pattern included the hunting of large and small game, fishing, and shellfish and plant collecting, in addition to horticulture. Migratory birds and some marine mammals were also captured (Simmons, 1978). These resources were utilized in a complex yearly cycle based on changes of residence in order to effectively exploit the various environmental zones.

By the time of the first European settlement in the 17th century, indigenous tribes along the coast and lower river valleys had already experienced changes through trade and disease contracted earlier from European traders and explorers.

Indians of North Haven at the Time of White Settlement

The divisions and connections between tribes in Connecticut were often loose and tribal boundaries often fluctuated, which makes it difficult to distinguish one tribe from another or to determine the exact location of each. Furthermore, ethno-historical information on Connecticut Indians is fragmentary and scattered. However, there is enough information available to provide a general idea of the location and status of the various tribes from the time of the earliest white settlements in the area, the 1630's, when written accounts first appear.

The present New Haven-North Haven area was occupied by the Quinnipiac Indian tribe, which extended through Guilford, East Haven, Branford and North Branford to the shoreline (DeForest, 1852:52). Northeastward, around the present Middletown, was the seat of the Paugussett nation - the Pequannocks, Wepawaugs, Pootatucks, Naugatucks, and the Paugussetts proper-covering most of Fairfield County and some of New Haven County. Eastward lived the Hammonassetts in the Saybrook-Clinton-Killingworth area and the Menunketucks in the Guilford-Madison area - two small tribes.

The Quinnipiacs appear to have been under the thumb of the powerful Pequot tribe, as were many of the smaller tribes in southern and central Connecticut (Gookin, 1970:7). The Pequots were based in southeastern Connecticut, near the Mystic River area, but controlled most of the area from the Connecticut River to the Rhode Island border, up to Nipmuck territory in Windham County. The Pequots extracted tribute, or taxes, from the Quinnipiacs, as did the Mohawk Indians, who came down from New York to hunt in the area.

The Pequot tribe was defeated by the English in the Pequot War of 1637 and nearly exterminated. Thus, the Quinnipiacs were relieved of one threat, but the Mohawks continued to plague them. As a result, when the founders of New Haven Colony arrived in 1638 seeking to make a settlement, the Quinnipiacs were willing to exchange their lands in order to obtain English protection. The Indians retained hunting and fishing rights on the lands as well as a small reservation, probably located in East Haven. At the time of this agreement, the Quinnipiacs stated the number of men and youths in the tribe to be 47, which may translate into approximately 150 persons; in any case, a relatively small population. According to DeForest (1852:165) the tribe had a fort on the reservation and subsisted mainly on shellfish from the harbor.

Apparently, the North Haven settlers enjoyed peaceful relations with the Quinnipiacs, since there are no recorded instances of conflict.

The data on the population of the Quinnipiacs during the 17th and 18th centuries are unclear. In 1680, according to Townshend (1900:191) the tribe numbered around 100 men (it is unclear whether or not this included women and children). However, the number appears to have steadily declined throughout the late 17th and 18th centuries, partly due to the participation and resulting loss of life by Quinnipiacs in the various wars throughout the years on behalf of the colonists. The reservation also steadily diminished in size as parcels were sold or lost to the area settlers. Indians left and moved to other areas as the land diminished. A number of them moved to Farmington in 1768 to live among the Tunxis Indians (DeForest 1852:361). Others were absorbed into the white society or into other Indian groups. Most likely, they could not support themselves on the small amount of land left in East Haven. It appears as though the remaining reservation land was lost some time in the late 18th or early 19th century.

History of North Haven, Connecticut

See "Assessment of Impact of the North Haven Mall on Historic and Cultural Resources in North Haven, Connecticut" (The Preservation Partnership, 1980) for a discussion of the history of North Haven.

ATTACHMENT D

Table D-1

ARTIFACT INVENTORY LIST

Attribute	Number of Items					
	T7-1	T7-2	T10-1	T24-1	MD-1	T25-1
Kind of Material						
quartz	1	1	1	8	11	4
chert/flint	0	142	1	14	4	1
slate	0	0	0	4	5	0
basalt	1	0	0	0	0	0
Kind of Object						
flake	0	139	2	25	10	5
chunk	0	0	0	0	0	0
core	0	0	0	0	0	0
formed	2	2	0	0	1	0
blade	0	0	0	1	0	0
State of Object						
whole	2	30	2	25	20	5
fire-cracked	0	2	0	0	0	0
fragment	0	1	0	0	0	0
shatter	0	108	0	1	0	0
Kind of Wear						
nicked	0	0	0	0	0	0
chipped (feather)	1	3	0	5	1	0
chipped (step/hinge)	0	0	0	0	0	0
crushed	0	0	0	0	0	0
polished	1	0	0	0	0	0
Location of Wear						
edge (unmodified)	0	2	0	4	0	0
unifacial edge	1	0	0	0	1	0
edge to a point	1 *	0	0	0	0	0
point	1 *	0	0	1	0	0
surface	1 *	0	0	0	0	0
bifacial edge	0	1	0	0	0	0

*One item

Table D-1

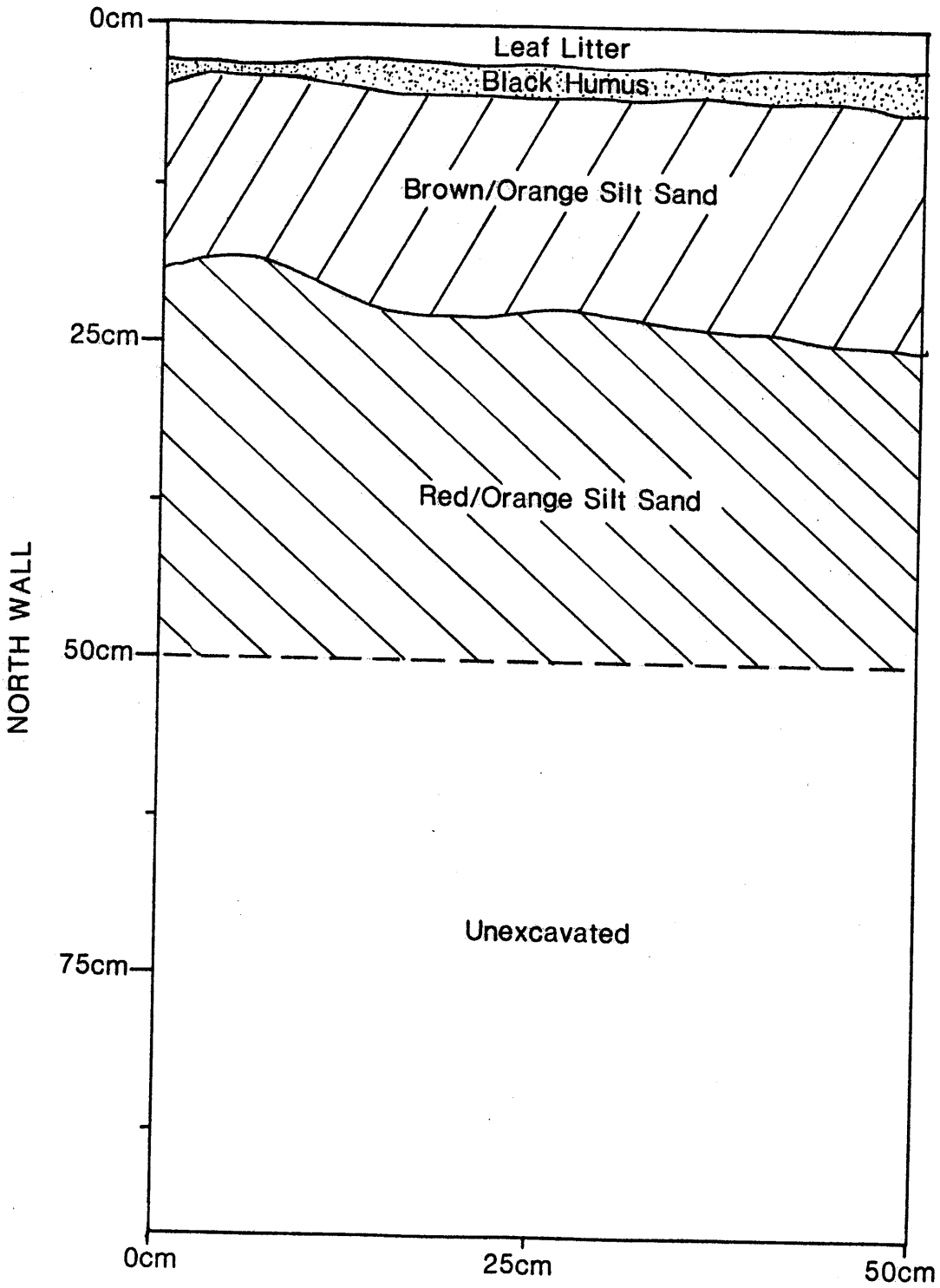
ARTIFACT INVENTORY LIST
(Cont.)

Attribute	Number of Items					
	T7-1	T7-2	T10-1	T24-1	MD-1	T25-1
Plane of Wear						
convex	0	1	0	1	1	0
concave	0	0	0	0	0	0
straight	2	2	0	3	0	0
sinuous	0	0	0	0	0	0
projection	0	0	0	1	0	0
notch	0	0	0	0	0	0
Orientation of Wear						
parallel	0	0	0	0	0	0
oblique	0	0	0	0	0	0
perpendicular	2	3	0	5	1	0
Edge Angle						
low (0 - 30°)	2	3	0	5	0	0
medium (31 - 60°)	0	0	0	0	1	0
high (61 - 90°)	0	0	0	0	0	0
obtuse (90°+)	0	0	0	0	0	0
Flakes						
whole	0	33	2	23	19	5
fragments	0	108	0	3	0	0
Kind of Flake						
biface reduction	0	3	0	2	1	0
re-sharpening	0	0	0	0	18	2
blade	0	0	0	1	0	0
amorphous	0	136	2	23	0	3
Form Tools						
drill	2	0	0	0	0	0
biface	0	2	0	0	0	0
scraper	0	0	0	0	1	0
uniface	0	0	0	0	0	1

Table D-2

ARTIFACTS: SITE T7-1

Pit #	Artifacts	Termination Depth (cm)	Comments
NOEO	None	57.0	Fire-cracked rock (20-35 cm)
NOE2.5	Quartz biface? (30 cm)	50.0	
NOE5	None	40.0	
NOE10	None	57.0	
NOW2.5	Lithic (?) 25-30 cm	60.0	
NOW5	None	50.0	Fire-cracked rock (20-30 cm)
NOW10	Quartz biface (15 cm)	50.0	
NOW15	None	60.0	
NOW20	None	44.0	
N2.5EO	None	48.0	Fire-cracked rock (25-30 cm)
N5EO	None	40.0	
N10EO	None	40.0 - 50.0	
N20EO	None	45.0	Fire-cracked rock (0-30 cm)
N30EO	None	35.0	
N40EO	None	40.0	
N2.5E2.5	None	50.0	Fire-cracked rock in upper levels
N5E5	None	60.0	
N10E5	None	60.0	
N10E10	None	48.0	
N20E2.5	None	35.0	
N2.5W2.5	None	60.0	
N5W5	None	44.0	
N10W10	None	45.0	
N20W2.5	None	38.0	
S1E1	None	40.0 - 50.0	Fire-cracked rock (25-30)
S2.5E2.5	None	40.0	
S2.5E5	None	40.0	Recent ash lens on surface
S5E2.5	None	50.0	
S1W1	None	40.0 - 50.0	Profile drawn. All pits contain similar stratigraphy
S5W10	None	38.0	
S6E0	None	40.0	
S10E10	None	45.0	



Source: Public Archaeology Survey Team, Inc., 1980

Site: T7-1/Pit# S1 W1

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

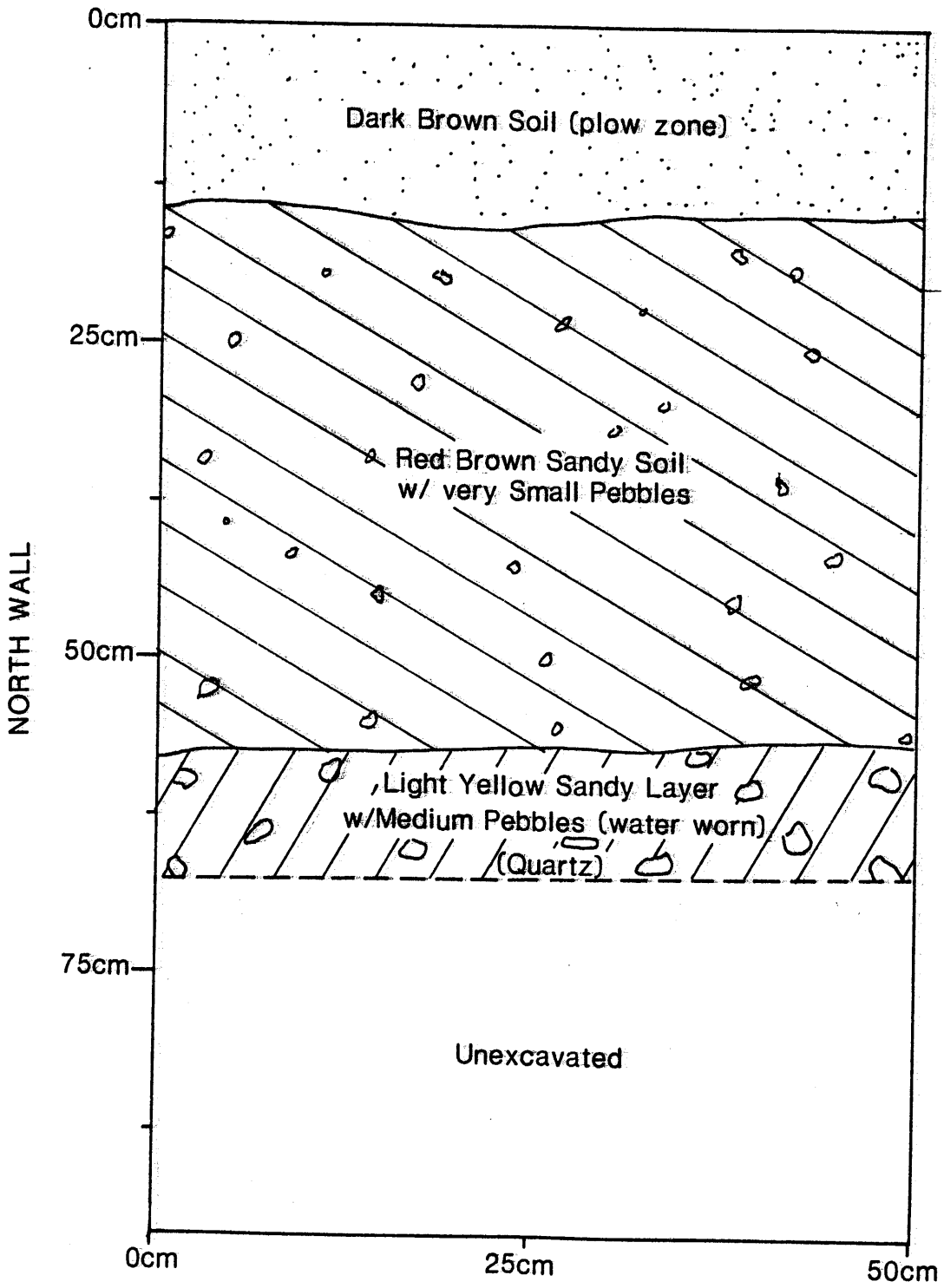
JASON M. CORTELL and ASSOCIATES INC.

Figure D-1

Table D-3

ARTIFACTS: SITE T7-2

Pit #	Artifacts	Termination Depth (cm)	Comments
NOEO			Excavated during Phase I as T7P13
NOE2.5	Lithics 20-60 cm	60.0 - 70.0	Highly gravely sand layer below 60 cm. Many flakes were found below plowzone, profile drawn.
NOE5	Lithics in high densities to 60.0 cm	60.0 - 70.0	Lithic distribution similar to that of NOE2.5
NOE10	Possible quartz flake at 30-40 cm	40.0 - 50.0	
NOE15	None	40.0	Very gravely matrix below plowzone
NOW2.5	2 flakes at 30.0 cm	43.0	
NOW5.0	Few flakes between 0-30 cm	38.0	Pit terminated due to massive root obstruction
NOW10	None	40.0	
N5EO	None	50.0	
N10EO	None	45.0	
N15EO	None	34.0	Pit terminated due to massive root obstruction
S5EO	1 flake in plowzone	42.0	
S10EO	None	40.0	
N2.5E5	Lithics to 50.0 cm	50.0 - 60.0	Lithic distribution similar to that of NOE2.5
N5E5	None	50.0	
N5W5	2 quartz flakes (20-40 cm)	50.0	
N5W10	None	44.0	
N10W6	None	54.0	
N10W10	None	50.0	
N15W5	None	44.0	
S2.5E5	Flakes in high densities to 30.0 cm	62.0	Lithic distribution similar to that of NOE2.5
S5.E5	None	50.0	
S10E10	None	52.0	
S5W5	None	45.0	



Source: Public Archaeology Survey Team, Inc., 1980

Site: T7-2/Pit#NO E2.5

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

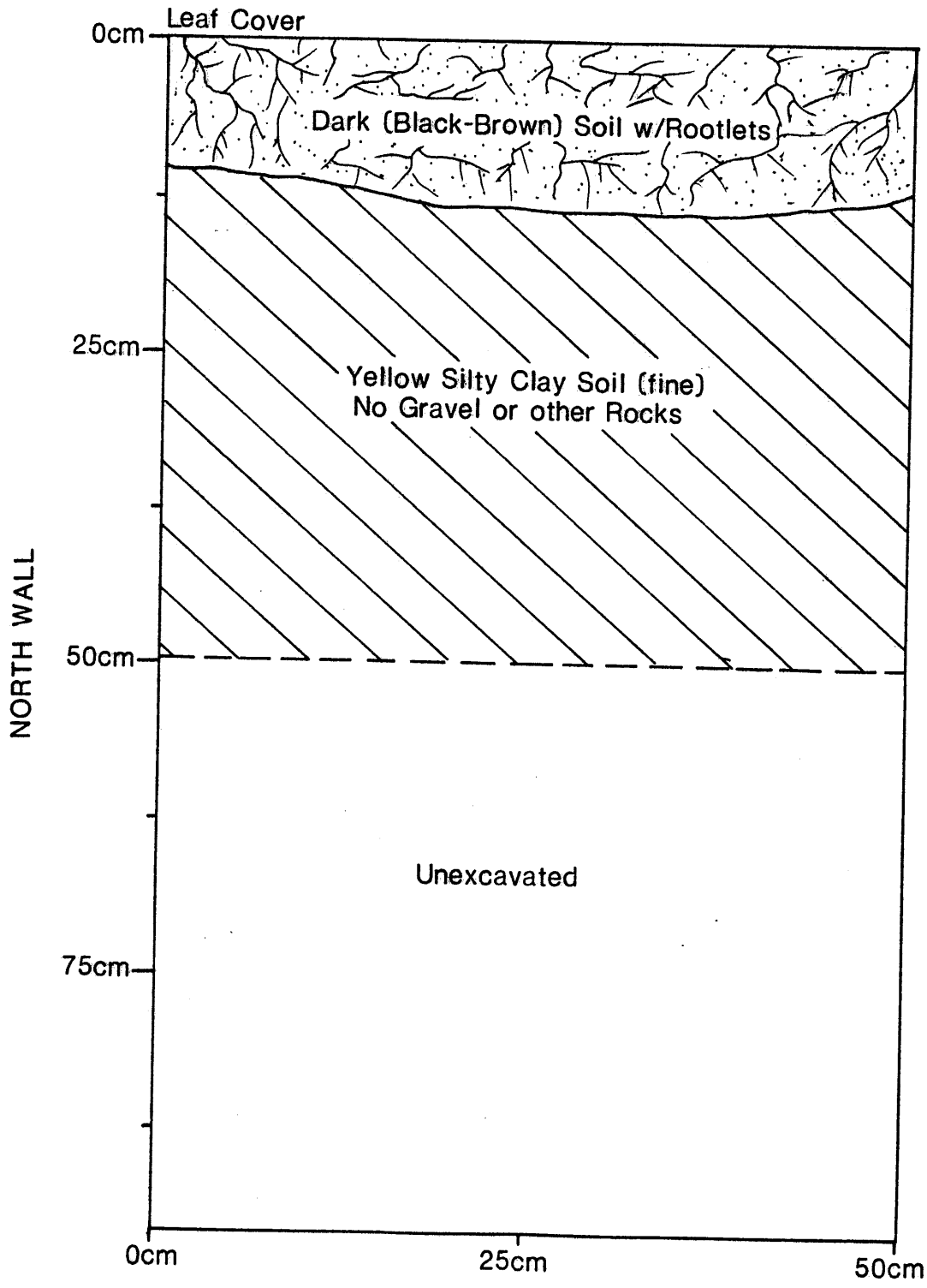
JASON M. CORTELL and ASSOCIATES INC.

Figure D-2

Table D-4

ARTIFACTS: SITE T10-1

Pit #	Artifacts	Termination Depth (cm)	Comments
N0E0			Excavated during Phase I as T10-P16
N0E5	None	50.0	Profile drawn.
N0E10	None	50.0	
N0W5	None	75.0	
N0W10	None	47.0	
N5E0	None		Excavated during Phase I
N10E0	None	50.0	
N15E0	None	50.0	
S5E0	None	56.0	
S10E0	Glass fragment (20-30 cm)	50.0	Profile drawn. Pit located at base of rise (levee).
N5E5	None	50.0	Stratigraphy somewhat different
N10E10	None	50.0	to that of the NE and NW
N5W5	None	50.0	quadrants.
N10W10	None	55.0	
S5E5	None	52.0	
S10E10	None	60.0	
S5W5	None	57.0	
S10W10	None	52.0	



Source: Public Archaeology Survey Team, Inc., 1980

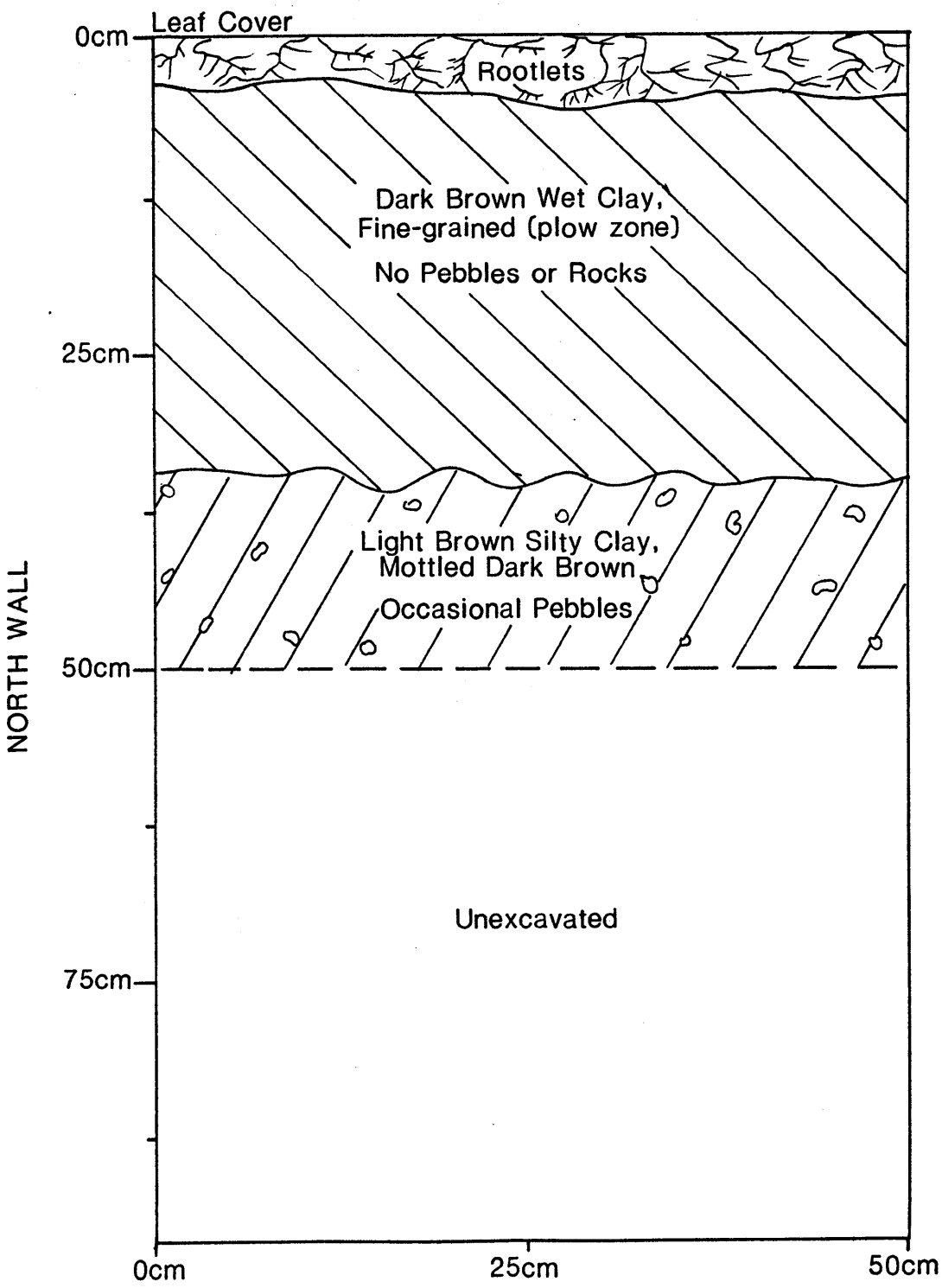
Site: T10-1/Pit# N0 E5

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

JASON M. CORTELL and ASSOCIATES INC.

Figure D-3



Source: Public Archaeology Survey Team, Inc., 1980

Site T10-1/Pit# S10 E0

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

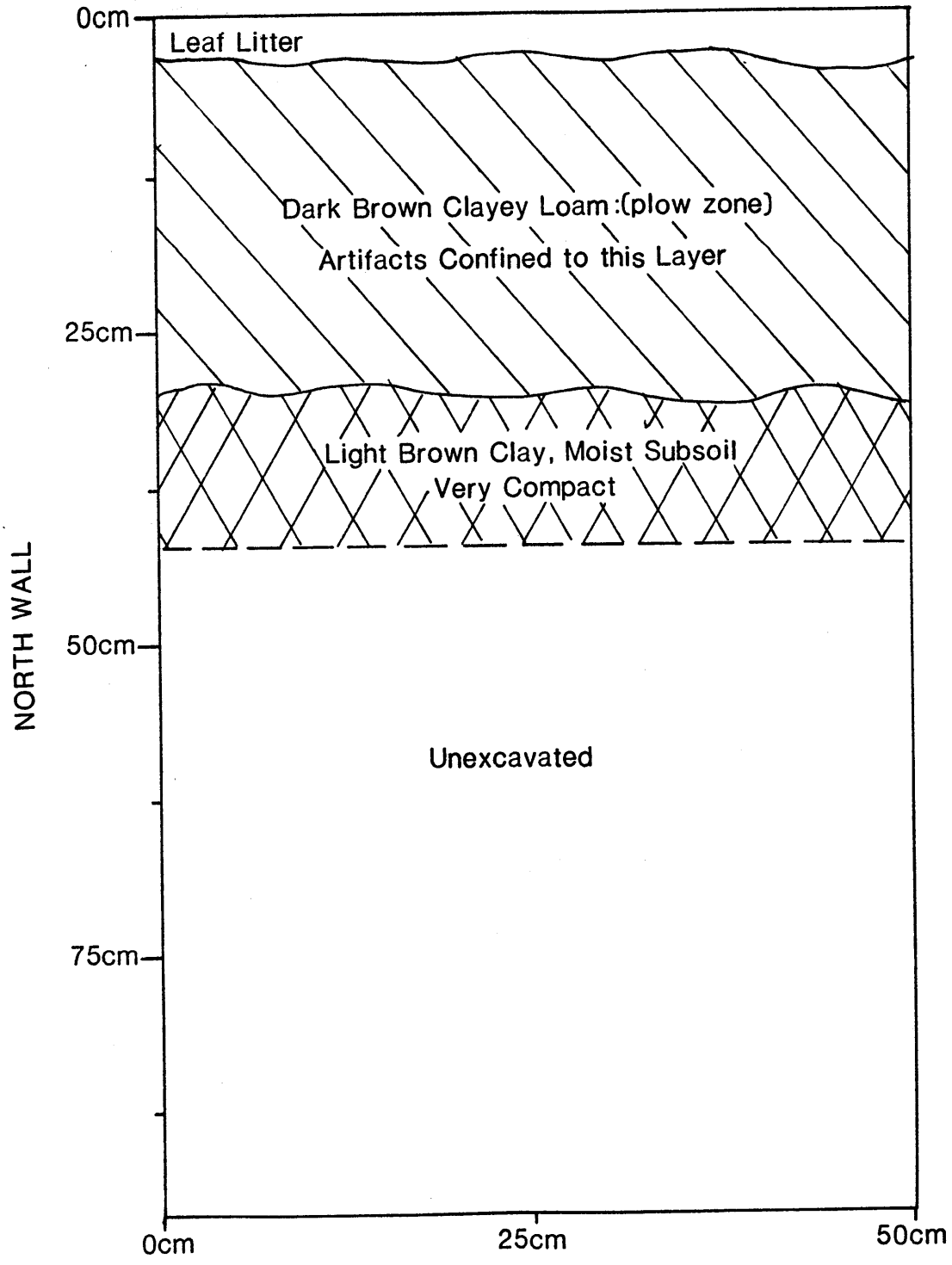
JASON M. CORTELL and ASSOCIATES INC.

Figure D-4

Table D-5

ARTIFACTS: SITE T24-1

Pit #	Artifacts	Termination Depth (cm)	Comments
NOEO			Excavated during Phase I as Pit T24-P7
NOE5	Historic (0-30 cm)	43.0	Profile drawn
NOE10	Mixture of historic and lithic (0-30 cm) lithic (40-50 cm)	60.0	Material in 40-50 cm level may occur below the plowzone. Charcoal flakes in low densities are present in the same level.
NOE15	1 flake (20-30 cm)	40.0 - 50.0	Occasional charcoal specks between 10-30 cm.
NOE20	None	45.0	
NOE25	None	38.0	
NOW5	Historic (0-30 cm)	43.0	
NOW10	Historic (0-20 cm)	43.0	
NOW15	None	43.0	
N5EO	Mixture of historic and lithic (0-30 cm)	45.0	
N10EO	None	40.0	Fire-cracked rock (1 frag.) recovered between 10 and 20 cm
S5EO	Mixture of historic and lithic (20-30 cm) 1 blade (30-40 cm)	40.0 - 50.0	Plowzone ends at 30 cm charcoal specks at 30-40 cm
S10EO	1 flake (0-10 cm)	60.0	Profile drawn. Plowzone appears very deep in this unit
S15EO	None	45.0	
N5E5	Mixture of historic and lithic (10-20 cm)	45.0	
N10E10	Mixture of historic and lithic (0-30 cm)	45.0	
N10E15	None	42.0	
S5E5	Historic (0-40 cm)	47.0	
S5E15	Mixture of historic and lithic (0-20 cm)	45.0	Terminated in very compact clayey subsoil below plowzone
S5E20	None	40.0	Plowzone only 20 cm thick in this unit
S10E10	Mixture of historic and lithic (10-50 cm)	60.0	Lithic material below 40 cm originates from below plowzone
S10E15	Very few artifacts above 50.0 cm quartz flakes (45-60 cm)	65.0	Dark deposit below 45.0 containing charcoal and bone fragments as well as quartz flakes. This layer does not occur in units S10E10, S12.5 10 and may occur S10E20 Profile drawn.
S10E20	Historic (10-20 cm)	45.0	Unit was terminated just above darker zone similar to that of S10E15
S12.5E10	1 iron frag (0-10 cm)	50.0	No undisturbed cultural layer similar to above pits



Source: Public Archaeology Survey Team, Inc., 1980

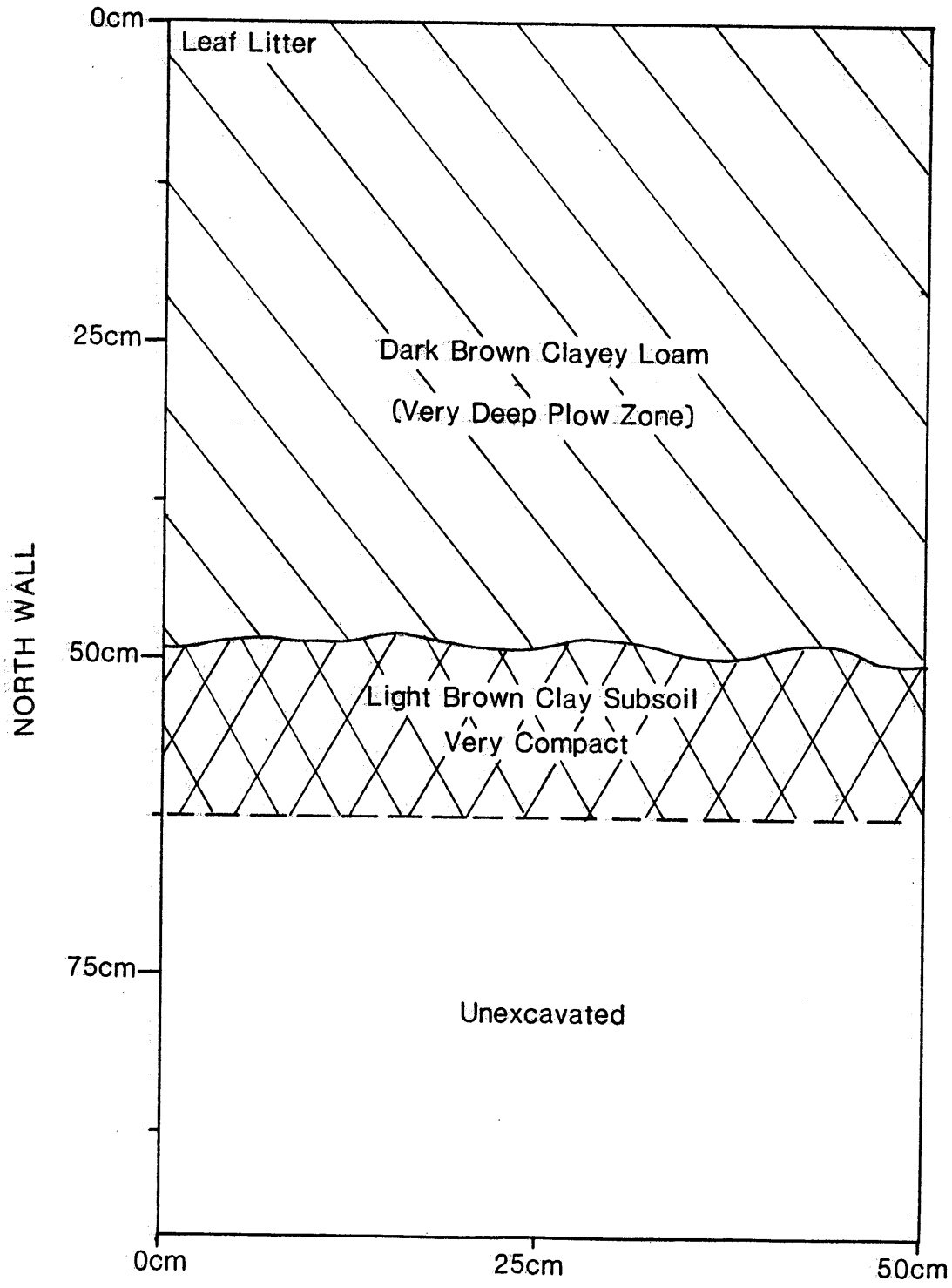
Site: T24-1/Pit#N0 E5

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

JASON M. CORTELL and ASSOCIATES INC.

Figure D-5



Source: Public Archaeology Survey Team, Inc., 1980

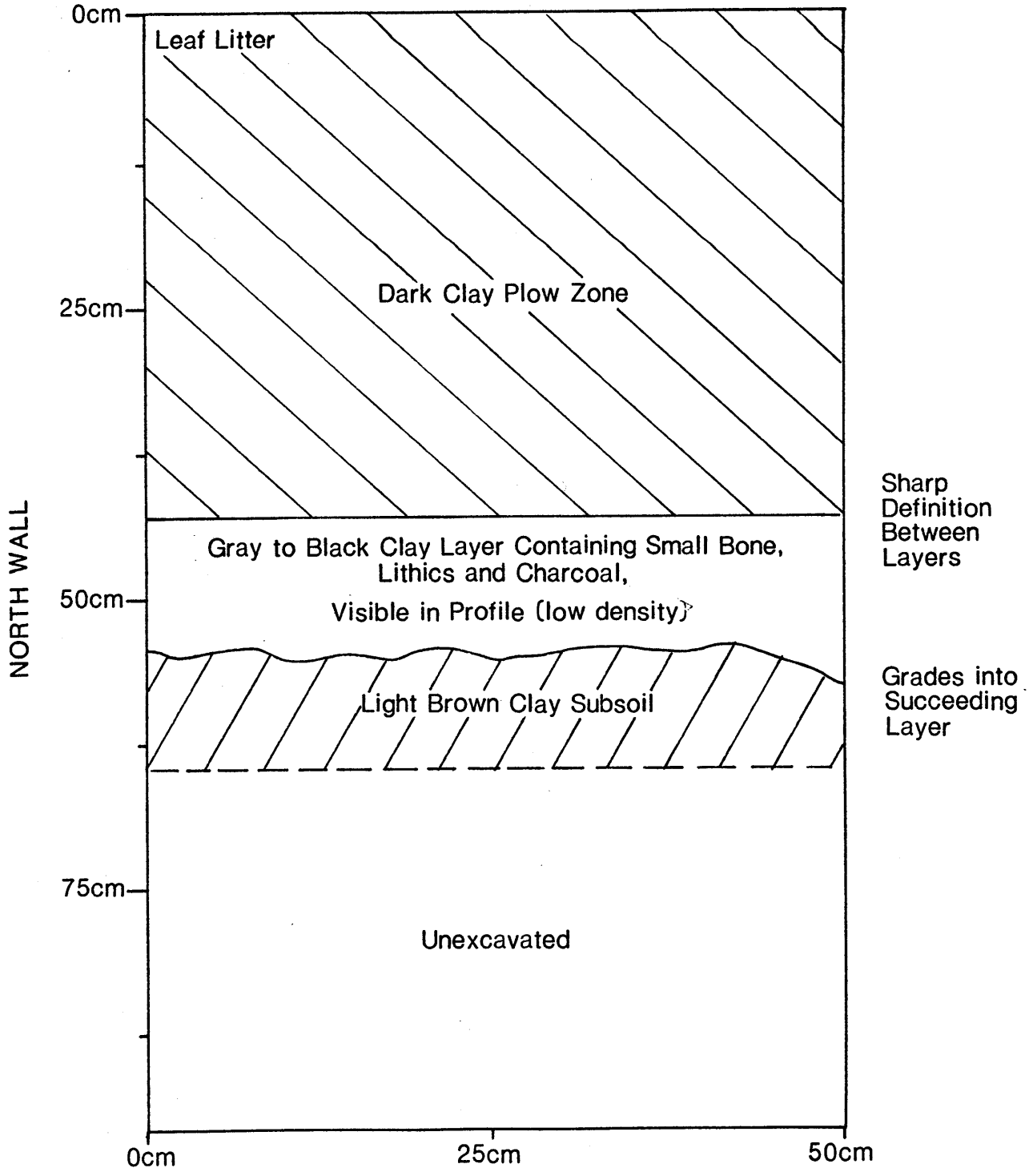
Site: T24-1/Pit#S10 E0

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

JASON M. CORTELL and ASSOCIATES INC.

Figure D-6



Source: Public Archaeology Survey Team, Inc., 1980

Site: T24-1 Pit#S10 E15

NORTH HAVEN MALL
North Haven, Connecticut

SOIL PROFILE

JASON M. CORTELL and ASSOCIATES INC.

Figure D-7

Table D-6

ARTIFACTS: SITE MD-1

Pit #	Artifacts	Termination Depth (cm)	Comments
NOW40	1 flint flake	35.0 - 40.0	
NOEO	1 quartz flake	35.0 - 40.0	
NOE40	1 quartz chunk	0.0 - 20.0	
NOE80	1 quartz flake	50.0 - 60.0	
NOE80	3 quartz flakes	40.0 - 50.0	
NOE80	1 quartz flake	40.0 - 50.0	
NOE80	2 quartz flakes	30.0 - 40.0	
N30E40	1 chert utilized uniface (scraper)	30.0 - 40.0	
S20W20	3 slate flakes	30.0 - 35.0	
N40WO	1 slate flake, 1 quartz flake	0.0 - 15.0	
S10E60	2 aboriginal ceramic sherds	25.0 - 30.0	
N20WO	1 chert flake	45.0 - 50.0	
S40EO	1 flint flake	30.0	
S10E60	1 aboriginal ceramic sherd	30.0	
S50EO	1 slate flake	25.0 - 30.0	
N30E)	1 quartz flake	30.0 - 40.0	

ATTACHMENT E

PLATE I

Quartz Uniface

Site T 7-1

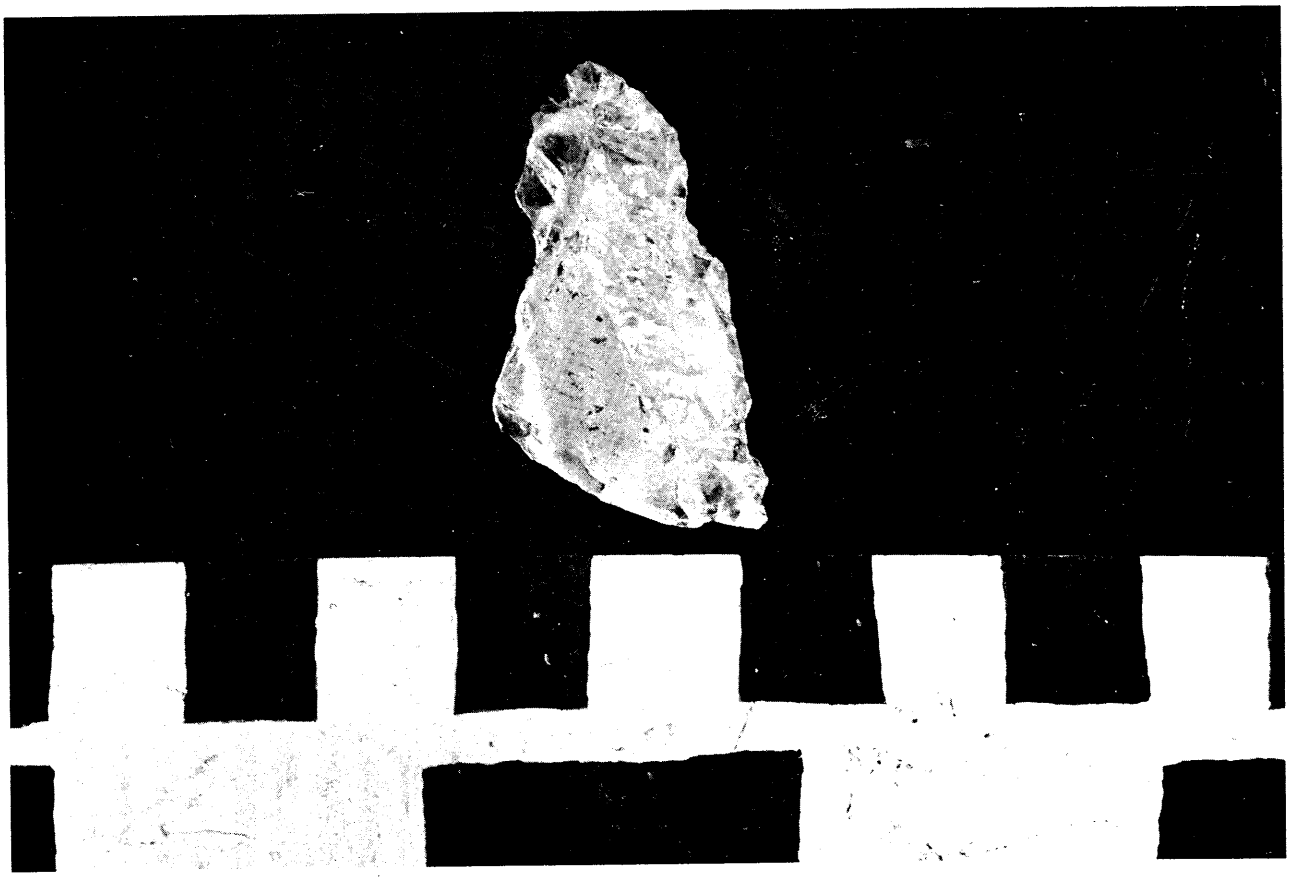


PLATE II

TOP: Chert Flakes
Site T 7-2

BOTTOM: Drill Tip
Site T 7-1

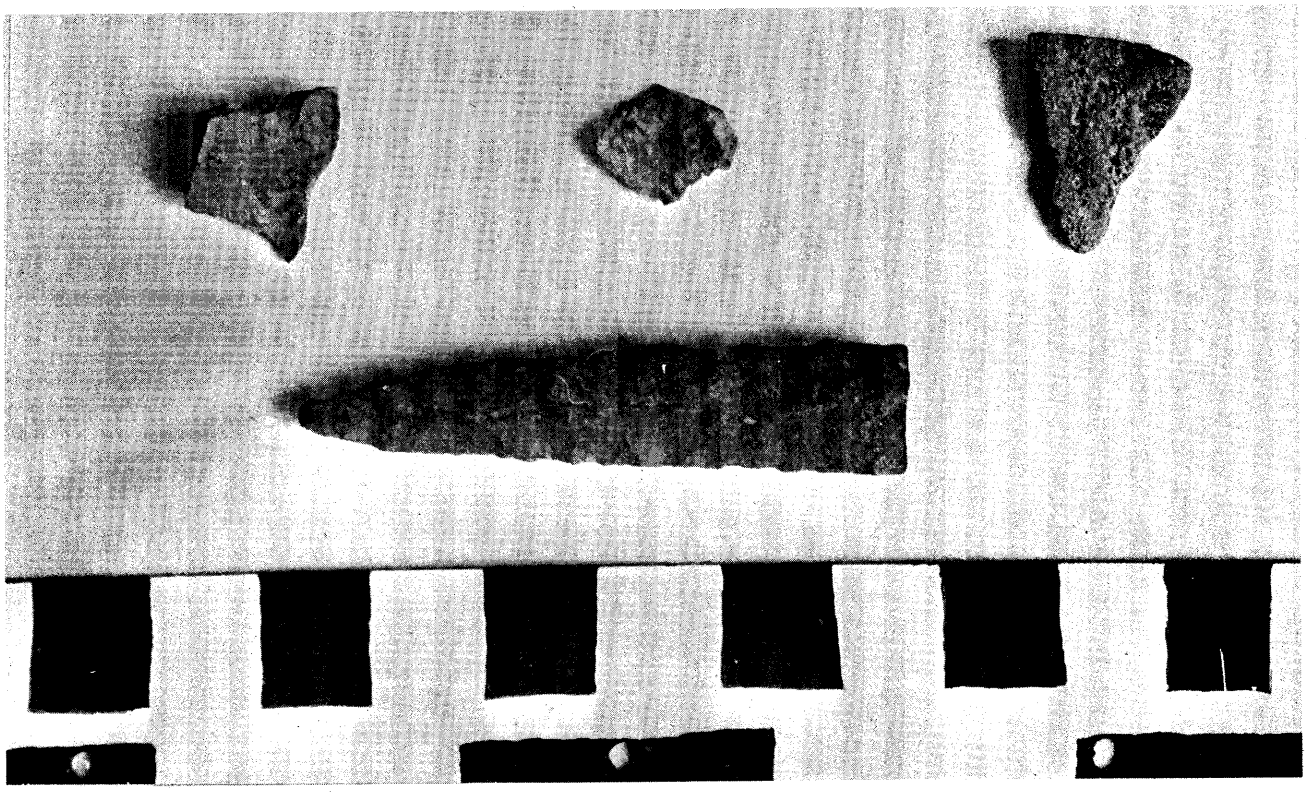


PLATE III

Chert Biface Fragments

Site T 7-2

PLATE IV

Chert Biface Reduction Flake

Site T 7-2

PLATE V

Chert Flakes

Site T 7-2

PLATE VI

Pit S10E15-cultural layer

Site T24-1

PLATE VII

Utilized Flint Flake

Site T24-1

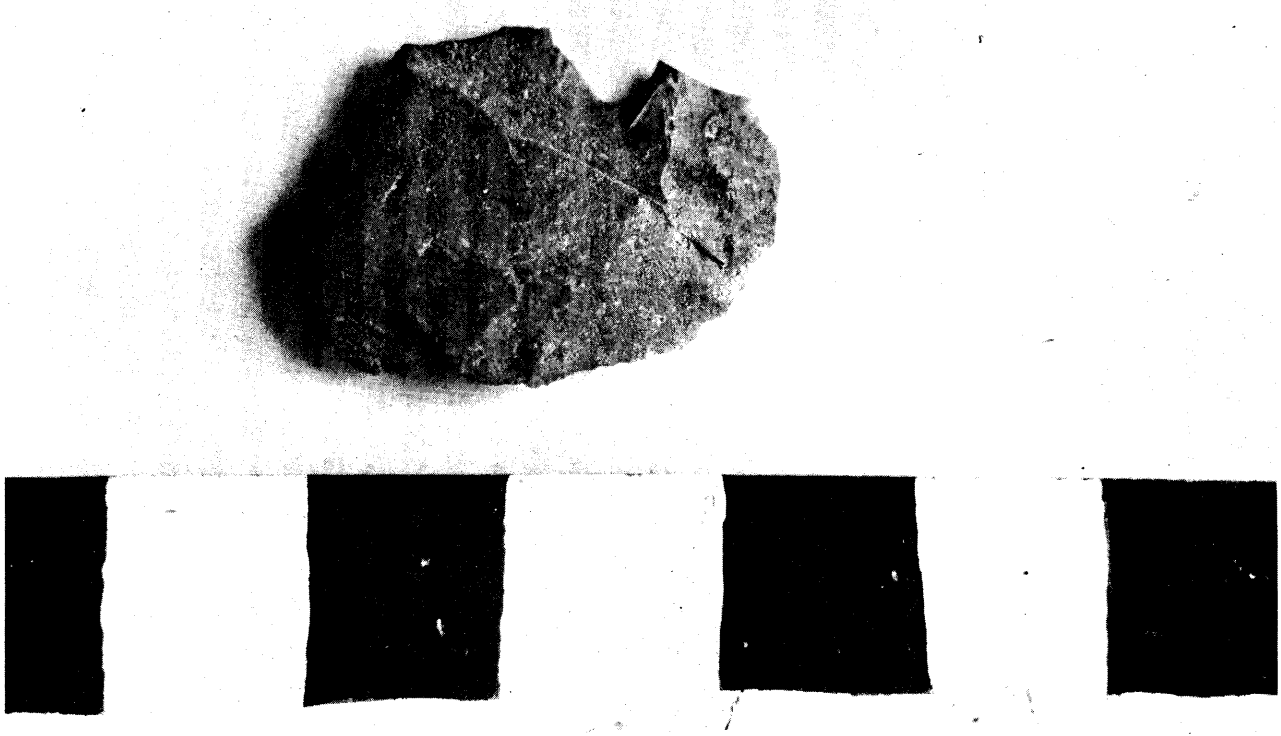


PLATE VIII

Utilized Chert Flake

Site T24-1

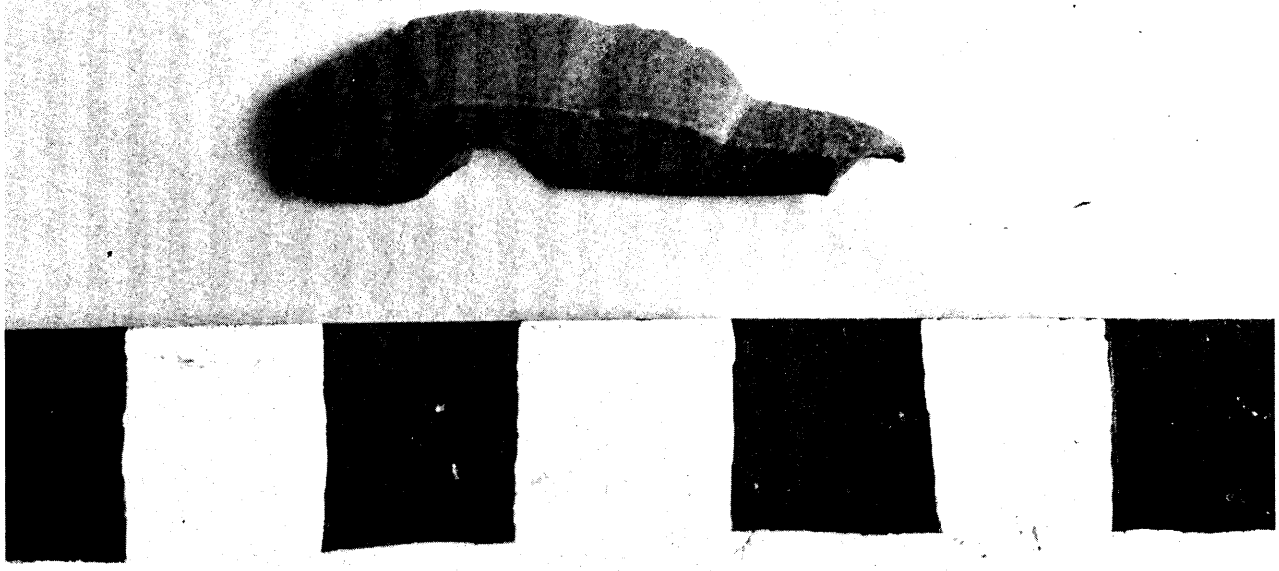


PLATE IX

Chert and Quartz Flakes

Site T24-1

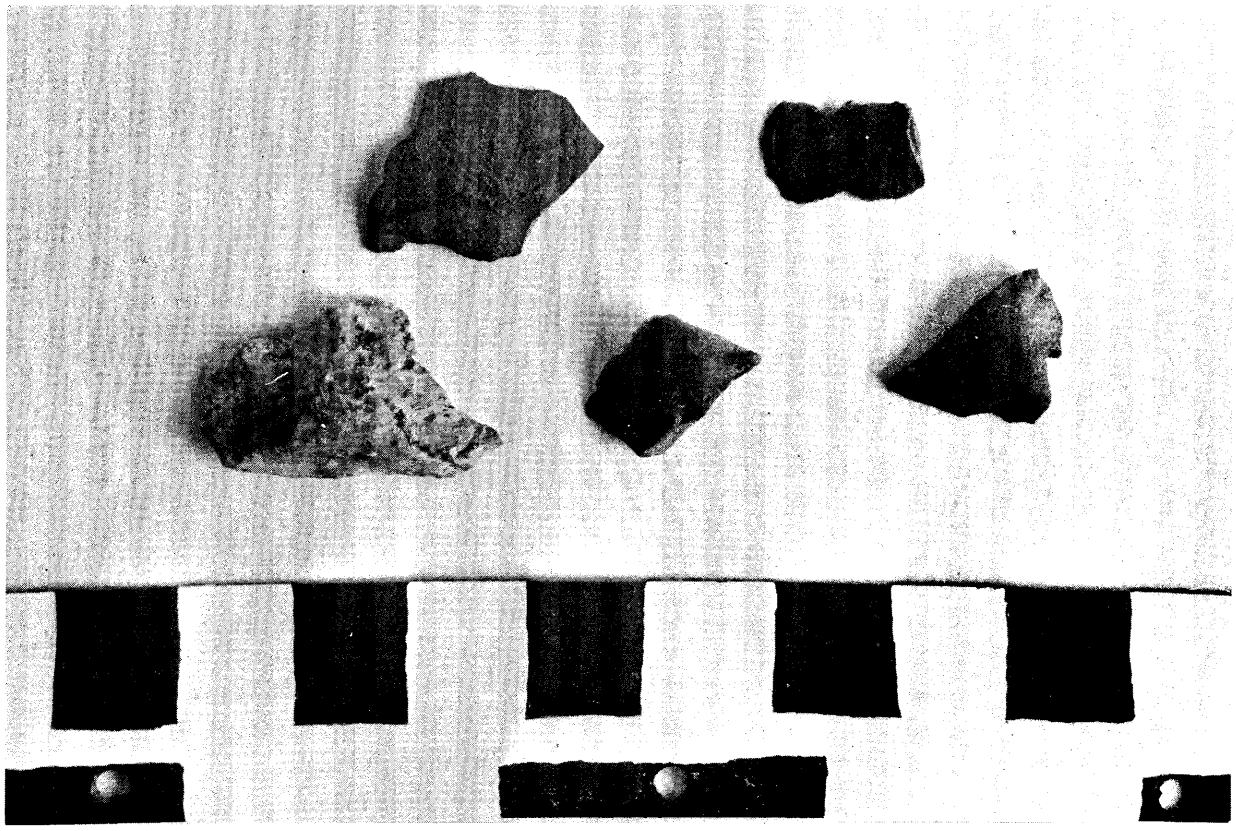


PLATE X

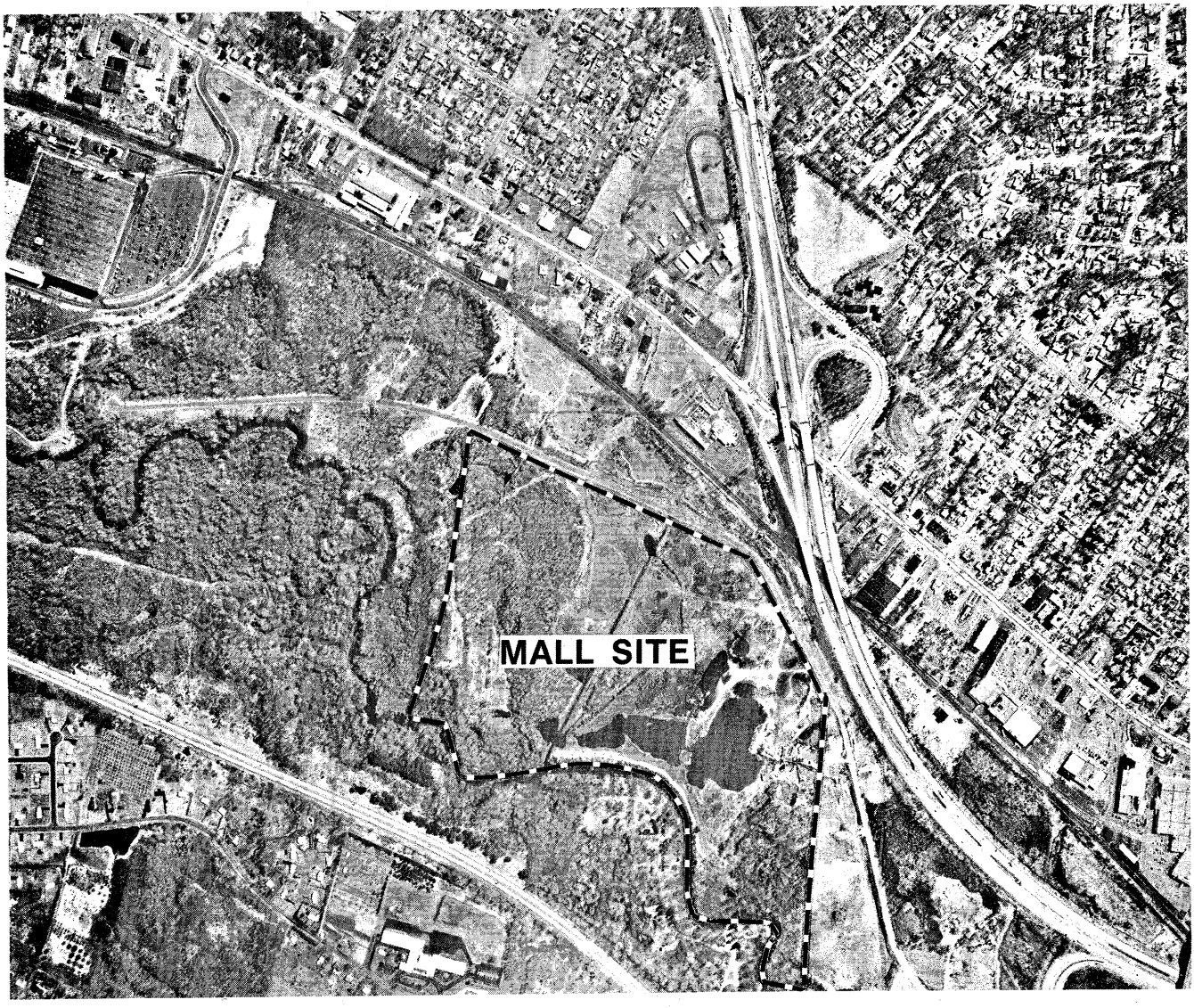
Chert Uniface

Site T25-1

APPENDIX P
Energy

NORTH HAVEN MALL

NORTH HAVEN, CONNECTICUT



1981

US Army Corps of Engineers
New England Division

Appendix P

Energy

The material contained in this appendix was prepared for Mall Properties, Inc., by Parsons Brinkerhoff Quade and Douglas, Inc. It has been provided to the Corps of Engineers as information in support of application #13-79-561 for a permit under Section 404 of the Clean Water Act of 1977, and Section 10 of the River and Harbor Act of 1899.

APPENDIX P

ENERGY

TABLE OF CONTENT

LIST OF TABLES AND FIGURES

APPENDIX P:

ENERGY

INTRODUCTION

This Appendix reports the findings of an Energy Impact Analysis, undertaken to determine the approximate quantities of energy which would be consumed as a result of Mall construction, operation and maintenance, and the impact this consumption would have on local energy supplies - specifically oil, natural gas, electricity and gasoline. As part of this effort, two areas of energy consumption were examined: (1) the actual energy that would be consumed at the Mall (onsite); and (2) the gasoline that would be consumed or saved by patrons, and by the transport of goods to and from the Mall (offsite). This appendix also includes a discussion of current energy conservation regulations affecting the design of the Mall, along with a description of the proposed heating and air-conditioning systems.

ESTIMATED ONSITE ENERGY CONSUMPTION FOR OPERATION AND MAINTENANCE

Onsite energy would be consumed by burning natural gas and fuel oil, and by purchasing electricity for the purposes of heating, air-conditioning, lighting and other building functions. The following sections describe how the estimates of energy consumption were made.

The Mall is actually five buildings, separately owned and operated. They are the Mall Stores Building, the R.H. Macy's Building, the Sears Building, the G. Fox Building and the J.C. Penney Building, as shown in Figure 1.

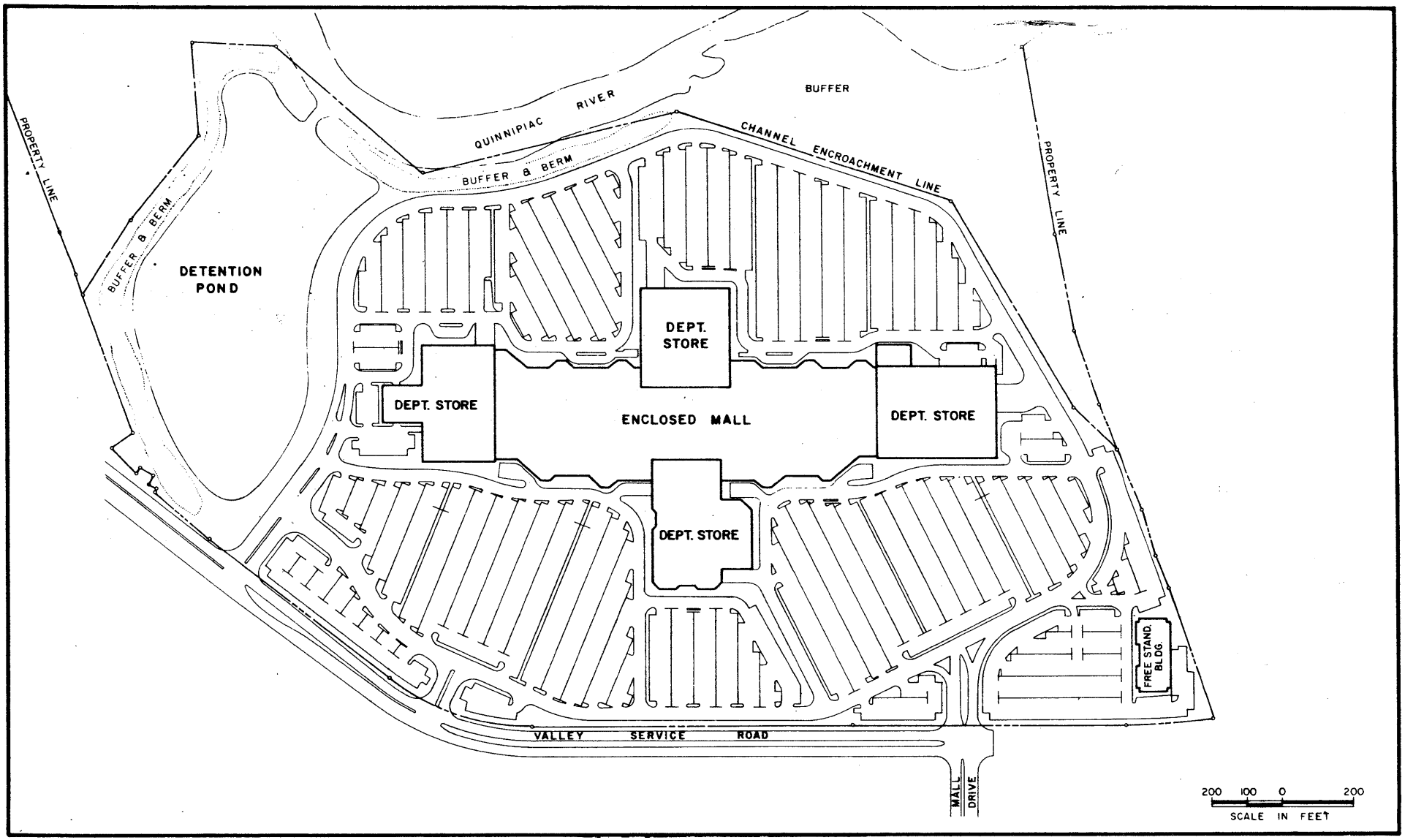
Energy demands have been calculated for each. At the current stage of Mall design, some building plans were closer to completion than others. Therefore, detailed energy consumption information varies for the buildings. This Appendix represents the best estimate of projected energy consumption, based on available information.

Heating

Calculations of space heating loads for the Mall were based on design proceedures in the ASHRAE Handbook of Fundamentals[1], the ASHRAE Applications Book[2], and similar equivalent methods, as required by the Building Code of the State of Connecticut, Section MCA-1305.52 - Calculations of Heating and Cooling Loads.[3]

Most of the space heating demand would be met by utilizing waste heat generated within the Mall, with the balance provided by various conventional heating systems. Waste heat would be given off by the interior lighting and electrical equipment, and heat would also be generated by patrons at the Mall. As an example, in the Mall stores building, average electrical lighting consumption (as designed by the project electrical engineer) is estimated to be 2 to 3 watts per square foot, which is equal to an average heat gain of approximately 8 to 12 million Btu/hr (based on a gross floor area of 1,138,035 sq. ft.). This heat gain is approximately equal to the peak heating load for the Mall.

Electrical equipment within the Mall would contribute lesser amounts of heat, depending upon equipment load and efficiency. Patrons using the Mall



North Haven Mall
Valley Service Road
North Haven, Connecticut

Figure 1
Site Plan

would also contribute to the internal heat gain within the building. The average heat gain from a patron would be approximately 450 Btu/hr, considering a normal percentage of male and female shoppers, and assuming the adult female output is 85 percent of an adult male.[4] With a peak hour Mall occupancy of 7,000-8,000 shoppers, the heat gain would be approximately 3 to 3.6 million Btu/hr. The energy consumption values for all five buildings, both peak and annual, are shown in Tables 1 and 2, respectively.

Mall Stores Building. The peak heating load in the Mall Stores Building is based on a design interior temperature of 70°F (21°c) when the exterior temperature is 5°F(-15°c), which based on historical data, would not be exceeded more than one percent of the time during the heating season. The 70°F design temperature is for design purposes and in most cases the interior temperatures, in the winter, would be maintained below this level.[5]

Heating within this building would be accomplished using a series of electric powered unit-heaters located under the roof and adjacent to the building entrance areas. This system, determined by the owner to be the most practical system for this building, would be used primarily to offset nighttime heat losses when the Mall building is unoccupied and lighting levels are reduced. The operating efficiency of this heating system would be close to 100 percent, based on converting the electrical energy to heat at the point of use. The overall efficiency of using electricity to heat, accounting for electric company generating plant efficiency and transmission losses from the plant to the Mall, is approximately 30 percent. On average, utilities use approximately 11,000 Btu of energy to make 1 kwh of electricity, which is equivalent to 3413 Btu of energy at the point of use.

G. Fox Building. The proposed heating system for the G. Fox Building is a natural gas-fired central boiler plant with a hot water distribution system. The efficiency for this boiler is approximately 75 percent.

The R.H. Macy's Building. The R.H. Macy's building is currently in the preliminary stages of design and, as such, the space heating energy demand has not yet been determined. Since this building is approximately the same size as the G. Fox Building, the heating demand will be about the same. At the present time, an electric resistance heating system is proposed for the building. The efficiency of this system is the same as that of the Mall Stores Building heating system, or close to 100 percent.

Sears Building. Two different heating systems are currently under consideration for the Sears Building. The preferred system would be comprised of a series of natural gas-fired unit heaters located throughout the building. The alternative system, if natural gas service is unavailable, would be an oil-fired central boiler plant with a hot water distribution system. The oil fired boiler would use No. 2 fuel oil as a fuel source. The average efficiency for both these system would be approximately 75 percent. If natural gas were available, it would probably be on an interruptable basis and, in the event of a shortage, private residences would get first priority on service.

J.C. Penney Building. The proposed space heating system for this building would be an oil-fired central boiler plant with a hot water distribution system. The efficiency for this type of boiler would be approximately 75 percent.

TABLE 1
PEAK ENERGY DEMAND FOR
THE NORTH HAVEN MALL COMPLEX

Building	SPACE HEATING (BTU/HR)	DOMESTIC HOT WATER HEATING (BTU/Day)	AIR-CONDITIONING (tons)	ELECTRICITY (kw)
Mall Stores	3,700,000	331,255	1,910	8,500
R.H. Macy's	5,500,000	458,150	300	700
Sears	4,000,000	331,255	300	700
G. Fox	5,500,000	458,150	350	720
J.C. Penney	4,000,000	331,255	380	900

Detailed energy demand information has not yet been estimated for all buildings, and as such some estimates were based on floor areas and comparisons with similar type buildings.

TABLE 2

ANNUAL ENERGY CONSUMPTION FOR
THE NORTH HAVEN MALL COMPLEX

Building	SPACE HEATING (in billion BTU)	DOMESTIC HOT WATER HEATING (in million BTU)	AIR-CONDITIONING (kwh)	ELECTRICITY (kwh)
Mall Stores	2.3	119.5	4,494,000	18,000,000
R.H. Macy's	1.7	334.2	700,000	4,500,000
Sear's	3.5	334.2	600,000	3,000,000
G. Fox	1.7	334.2	700,000	2,800,000
J.C. Penney	3.6	334.2	600,000	2,250,000

Detailed energy information has not been estimated for all buildings, and as such some estimates were based on floor areas and comparisons with similar type buildings.

Air-Conditioning

The air-conditioning load for the Mall was calculated based on design procedures described in the ASHRAE Handbook of Fundamentals, and similar equivalent methodologies, as required by the Building Code of the State of Connecticut, Section MCA 1305.52, Calculations of Heating and Cooling Loads. Ventilation rates and outdoor air changes are based on design criteria in the energy code, and would vary based on the function of the space and the occupancy.

The air-conditioning load for the Mall would be comprised of many internal and external heat gains at the facility. These heat gains include solar radiation, waste heat from lighting and electrical equipment, and heat gains from patrons in the Mall. These internal and external heat gains, which in the winter represent an added bonus in heating energy savings, introduce an additional penalty on the air-conditioning system during the cooling season. The peak air-conditioning demand and annual electrical consumption for the buildings are shown in Tables 1 and 2, respectively.

Mall Stores Building. The peak air-conditioning load for the Mall Stores Building was based on the following interior-exterior design conditions:

- o Interior $78^{\circ}F(26^{\circ}C)$ dry bulb (dB)
  50% relative humidity (rh)

- o Exterior $86^{\circ}F$ $(30^{\circ}C)$ dry bulb (db)
  $70^{\circ}F$ $(21^{\circ}C)$ wet bulb (wb)

Selection of outside environmental conditions was based on historical meteorological data for the New Haven area, which statistically would not be exceeded more than 2.5 percent of the summer cooling period of 2980 hours.[6]

Air-conditioning would be accomplished in the Mall Stores Building using a series of roof-top unitary package air-conditioning systems distributed around the Mall building. A total of 33 direct expansion (DX) units of varying cooling capacities would be installed to serve both the tenant and the mall common spaces.

The unitary air-conditioning system was selected over a central cooling plant primarily because with a physical layout such as the Mall building (long and narrow corridors), an extensive piping network would be required in order to meet the varying cooling requirements of the building. The individual units eliminate piping energy heat gains, pump energy expenditures, and lag time inherent in large cooling systems with long horizontal piping runs. This system would also offer some back up cooling in the event of a unit failure.

Mall Building Tenant Units. The tenant areas would be air-conditioned with 29 units, 14 supplying the upper tenants and 15 supplying the lower tenants. The units would range in size from 40 - 70 tons (1 ton = 12,000 Btu) of refrigeration for the upper tenants, and 50 - 70 tons for the lower tenants. Each unit would supply a specific zone in the mall, with the connection between the unit and the zone it serves being made by a series of ducts. These air-conditioning units would have a variable volume air volume (VAV) air distribution system, which would allow for energy savings by controlling ventilation air quantities to meet the load requirements in the zone. When used for

varying load conditions, this type of system conserves substantial amounts of energy by reducing fan horsepower requirements, as a result of eliminating the movement of excess quantities of air. Thus the VAV system would be well suited for the tenant areas because of the varying cooling loads imposed by each of the stores, due to their varying patron loads and types of use.

Mall Stores Building Common Area Units. The mall common areas would be air-conditioned with four DX units, and each unit would have approximately 40 tons of refrigeration capacity. These units would be a constant air volume type, since the air-conditioning load in the common area would be more uniform than the store areas. The common area would be open whenever the Mall complex is open, unlike the stores which would have varying operating hours and changing air conditioning requirements.

Department Stores Air-Conditioning Systems. With the exception of the J.C. Penney Building, the department stores would be air-conditioned using central chilled-water refrigeration plants. These systems were selected over decentralized systems because the piping runs would be relatively short, due to the building configuration, and there would be a limited number of air-conditioning zones. These units would range in size from 300 to 400 tons/building.

The J.C. Penney Building would have a combination of a central plant and unitary direct expansion (DX) units. The central plant similar to the one described above would serve most of the building. The DX units would be used in the auto service centers and the small remote shops within the building.

The central plant would have a capacity of approximately 380 tons and the DX units approximately 35 tons.

Domestic Hot Water

The domestic hot water load would be comprised of a series of small loads scattered throughout the Mall to provide hot water to wash basins, janitorial equipment and restaurant equipment. The peak load and annual energy consumption are shown in Tables 1 and 2. The water heaters would either be oil or gas-fired, or electric powered, depending upon owner preference, and would be located near the points of use. In some instances, domestic hot water may be heated using the central boiler plants in the department stores.

Electricity

The electrical power consumption for the Mall is shown in Tables 1 and 2 for both peak hour and annual consumption. Electricity would be consumed for heating, air-conditioning, space and display lighting, escalators, elevators and other miscellaneous electrical equipment. The electricity used in the buildings would not affect electricity supplies within the North Haven area, since it would represent a very small peak load (11,000 kw) when compared to the total peak generating capacity of the United Illuminating Company (1,299,360 kw)[7], which is the local electrical utility. The North Haven Mall electrical demand would actually represent less than one percent of United Illuminating's generating capacity. After Mall demand is satisfied, the utility would still have approximately 30 percent excess capacity.

ENERGY CONSERVATION IN THE MALL

This section describes the energy conservation features that would be implemented in the Mall. As mentioned previously the Mall would be designed to conform to the Building Code of the State of Connecticut, Article MCA-13-A. The Code is an adaptation of the ASHRAE 90-75R Standard (Now 90A-1980) "Energy Conservation in New Building Design"[8].

The code specifies certain thermal design and mechanical equipment standards for the building design. These include standards for ambient interior design conditions, thermal performance of walls and roofs, and mechanical equipment. By complying with the standard, approximately 40 percent of the energy normally expended for heating, air-conditioning and other building services would be saved, without reducing the levels of service or comfort in the Mall.

One of the most important energy saving systems to be installed in some of the department stores, depending upon the mechanical systems, is an energy management system (EMS). Although not required by the Connecticut Building Code, this unit would save subtantial quantities of energy in the Mall. The EMS is a small computer system used to control the lighting, air-conditioning and heating systems within a building. The system maintains comfort levels within the building by sensing the load at critical locations within the building and responding in the most energy efficient manner. In the past, some buildings in shopping malls were heated and cooled simultaneously because there was no central environmental control device. The EMS avoids this wasteful practice by constantly monitoring the interior environmental conditions

and responding with either heating, cooling or outside ventilation air. As an example, in the G. Fox Building the EMS would also control the lighting and operate it according to the store schedule. The section below describes in further detail energy conservation features for the Mall.

Building Envelope

As part of compliance with the Energy Code, the Mall buildings would be designed to have a very low rate of heat loss through the walls and roof. As is typical with most malls, a large portion of the glass would be located at the entrances to the Mall. The total glass in the Mall buildings would represent a very small percentage of the total building surface area as compared to a normal commercial building, and as a result would use comparably less energy.

Heating

A substantial amount of energy would be saved by utilizing waste heat for space heating during the winter months. Major waste heat contributors are the space and display lighting systems and the heat generated by patrons using the Mall. As an example, a 100 watt fluorescent light bulb gives off approximately 340 Btu/hr. Other heat gains are described in the section on heating. In addition to recovering waste heat, interior temperatures would be reduced during non-operating hours to conserve energy. The temperature reductions would vary by store, but on average the temperature would be less than $60^{\circ}F$.

Air Conditioning

The air-conditioning units themselves would be designed to incorporate many energy conservation features. One of the major features of many of the air-conditioning systems would be the use of a variable air volume (VAV) system as opposed to a constant volume system. The VAV system delivers air in quantities as a function of the load requirements at any given time, as opposed to supplying a constant volume of ventilation air. The VAV system is most suitable for buildings with varying loads, similar to those found in the stores. The primary saving associated with the VAV system is the reduction in ventilation fan power requirements.

Another device that would be incorporated in the air-conditioning system, although not required, is an enthalpy/dry bulb economizer control. The enthalpy controller measures the total heat content of the outside air and the return ventilation air and utilizes the air that imposes the lowest energy load on the air conditioning system. This system is very useful during days when marginal air-conditioning loads are imposed on the systems.

Domestic Hot Water

Since the domestic hot water load would be marginal within the building, only energy conservation requirements required by the Code would be implemented. These would include such measures as using heavily insulated water heaters to minimize standby losses, and limiting maximum water temperatures.

Lighting

Many energy conservation features would be incorporated into the lighting system for the Mall. The most important feature would be the overall reduction in lighting levels within the stores. A large portion of the lighting would be task oriented as opposed to uniform lighting of the entire space. Most stores would reduce lighting levels significantly during non-operating hours, and in the case of the G. Fox Building, the interior lights would be completely turned off. This is one of the primary reasons that supplemental heating would be required in some stores. Although space heating with waste heat from lighting may seem practical, it is far more efficient to turn off the lights and use a conventional heating system to supply heat.

Other energy conservation features for lighting would include the use of metal halide lights and fluorescent lights. The relative lighting output efficiencies in lumens/watt for various types of light sources are as follows:

- Incandesent: 17 to 22 lumens/watt
- Fluoresent: 67 to 83 lumens/watt
- Metal Halide: 85 to 100 lumens/watt

In some cases incandescent lighting would be required as part of the display lighting, as it is more easily directed and has color rendering properties similar to the light under which the merchandise would be used. The balance of the lighting would be comprised of fluorescent and metal halide fixtures.

ADVERSE ENVIRONMENTAL IMPACTS

In general, the analysis has shown that there would be no significant impacts on energy consumption from the Mall.

The oil and natural gas-fired boilers in the Sears, J.C. Penneys and G. Fox buildings would present a relatively insignificant energy impact on the local fuel supplies, since each building would have a total fuel consumption equivalent to that of approximately 15 to 20 single family residences, with the total equivalent consumption from the Mall equal to approximately 100 homes.

The air-conditioning system for the four department stores would have a minor adverse impact from the discharge of cooling water. During peak operation approximately 500 to 620 gallons/hr of cooling tower water would be discharged into the sewage system, with lesser amounts during partial load conditions. The discharge would contain corrosion inhibitors and anti-fouling agents to control bacteriological growth. The impact of this discharge is discussed in Appendix K: Utilities.

ALTERNATIVE ENERGY SYSTEMS

At the present time no alternative energy systems (solar, wind, solid waste) are planned for the North Haven Mall. The main reason for this is the absence of favorable economic benefit associated with these systems for applications within the Mall.

Solar Energy

The only type of solar energy collection system that would have potential application, if a favorable economic picture developed, would be a series of solar domestic hot water heating systems. These systems would be designed to handle specific domestic hot water loads in each building. A typical system would be comprised of a bank of 3 to 4 collectors with a total area of 60 to 80 sq. ft., with a storage tank of 80 to 120 gallons capacity. Since parts of the Mall would be owned and operated separately, it cannot be determined which owners would install solar energy collection systems. If such systems were installed the savings would be modest, ranging from $700 to $1,000 over the life of the system. Table 3 shows the projected 20-year cash flow for a solar collection system, on a per-square-foot basis. If a small solar energy domestic hot water treating system were installed, the proposed roof structure would be adequate to support the additional load. A large scale central system would not be practical because of the long piping runs to each building, and joint ownership problems.

Wind Energy

Currently wind energy systems are in the experimental stage of design and have a very poor economic return. The area where the Mall would be located is not a site conducive to wind generation, as current wind generators must be located in areas with high average wind velocities (mountain peaks, flat open areas, and along the sea coasts). Based on the high capital cost and their unpredictable output, it would be impractical to install a wind generator on the site to provide electrical power.

TABLE 3

ANNUAL CASH FLOWS PER SQUARE FOOT OF SOLAR COLLECTOR AREA FOR SYSTEM LIFE

	Costs			Savings
Year	(7% Interest) Amortization	(7% Escalation) Maintenance	(13% Escalation) Pump Energy	(17% Escalation) Fuel Savings
1984	$ 6.62	$0.70	$0.07	$ 1.38
1985	6.62	0.75	0.08	1.61
1986	6.62	0.80	0.09	1.89
1987	6.62	0.86	0.10	2.21
1988	6.62	0.92	0.11	2.59
1989	6.62	0.98	0.13	3.03
1990	6.62	1.05	0.15	3.54
1991	6.62	1.12	0.16	4.14
1992	6.62	1.20	0.17	4.85
1993	6.62	1.29	0.21	5.68
1994	6.62	1.38	0.24	6.64
1995	6.62	1.47	0.27	7.77
1996	6.62	1.58	0.30	9.09
1997	6.62	1.69	0.34	10.64
1998	6.62	1.80	0.39	12.45
1999	6.62	1.93	0.44	14.56
2000	6.62	2.07	0.49	17.04
2001	6.62	2.21	0.56	19.94
2002	6.62	2.37	0.63	23.33
2003	6.62	2.53	0.71	27.29
Totals	$132.40	$28.70	$5.64	$179.67
	Total Savings:	$179.67		
	Total Costs:	$166.74		
	Net Savings:	$ 12.93		

TABLE 3

ANNUAL CASH FLOWS PER SQUARE FEET OF COLLECTOR AREA
FOR SYSTEM LIFE (Cont'd.)

ASSUMPTIONS:

Present capital investment cost 1979: $50/sq. ft. panel area
Life Cycle: 20 years
Average annual inflation rate: 7%
1979 Cost of gas: $0.28/100 cu. ft.
Annual escalation rate for gas: 10% above inflation rate
Total annual escalation rate for gas: 17%
Annual maintenance cost: 1% of capital investment adjusted for inflation rate.
Annual pumping cost for electrical energy: .1% of capital investment adjusted for escalation and inflation rates.
Annual escalation rate for electricity: 6% above inflation rate.
Total annual escalation rate for electricity: 13%
Annual interest rate for capital investment: 7%
Annual construction cost inflation rate: 12%
Annual fuel savings for solar panels: 225 cu. ft. gas per sq. ft. of panel area.
Capital investment 1982: $50/sq ft. x 1.405 = $70/sq. ft.
Annual maintenance for 1st year of operation: $70 x 0.01 = $0.7/sq. ft.
1st Year of operation: 1984
Gas rate for 1984: $0.28/100 CF x 2.192/ = $0.61/100 cf
Gas fuel savings for 1984: $0.61/100 cu. ft. x 225 cu. ft. = $1.38/sq. ft.
Amortization of capital investment: $70 x 0.09452 = $6.62/sq. ft./yr.

Solid Waste

There are many physical problems associated with using solid waste as an alternative energy supply. These include storage, disposal of residues, and compliance with stringent air quality regulations. There are also economic problems resulting from the high capital cost of the equipment and its limited rate of utilization, which result in a high unit cost for the energy recovered from the system. The only economically justified systems are those with large assured quantities of solid waste material. Currently most systems are scaled to burn solid waste from an entire city to produce power. Under present conditions, it does not appear to be feasible to use solid wastes generated at the Mall complex as an alternate energy source.

CONSTRUCTION ENERGY CONSUMPTION

The construction energy consumption is the energy required to manufacture, transport and place the construction material within the structure. This quantity of energy is commonly referred to as the embodied energy of the material.

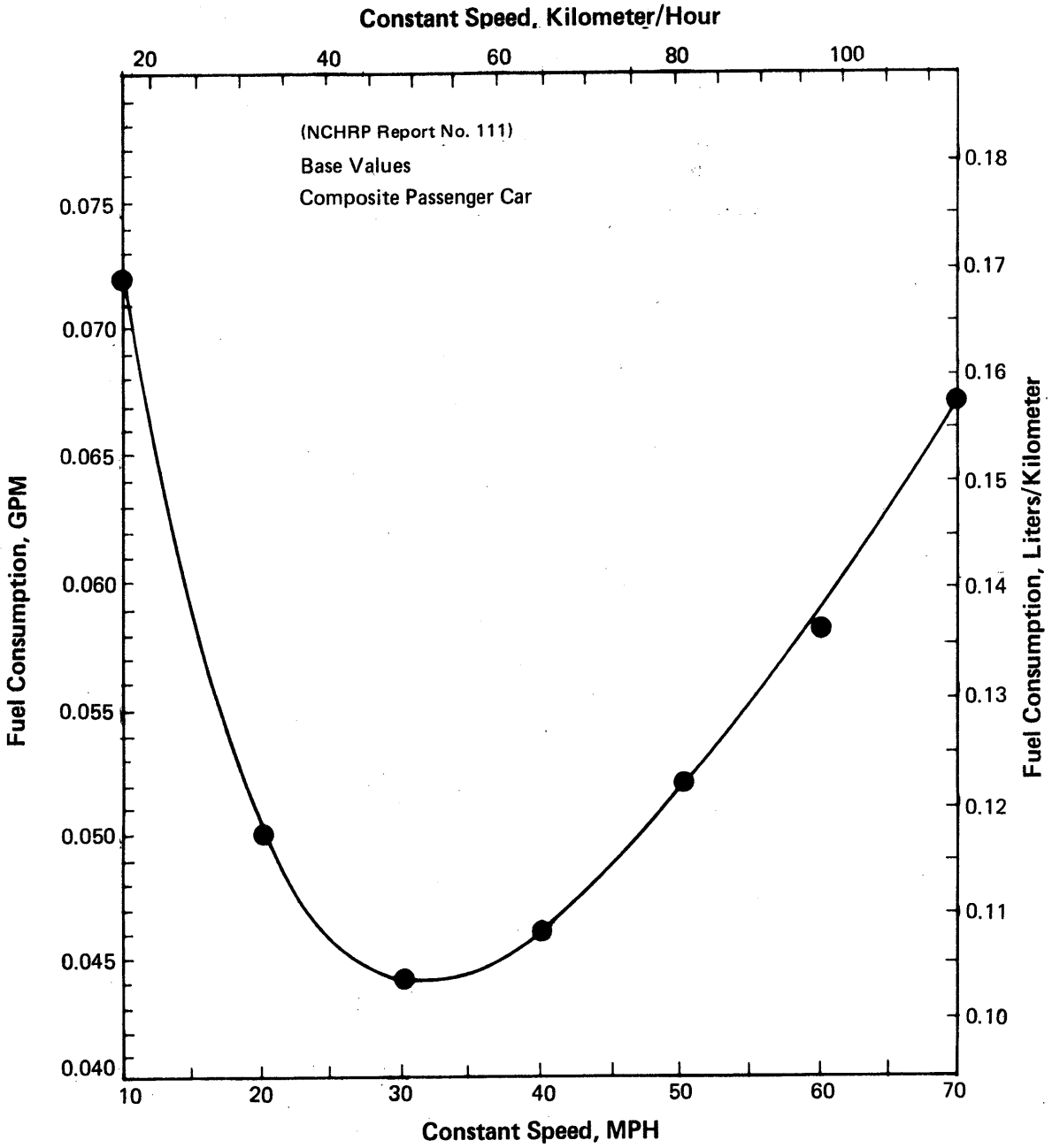
Construction energy consumption estimates were based on a national average value of 219,637 Btu sq./ft.[10] for new construction of stores and restaurants. The total construction energy consumption for the Mall was estimated to be from 20 billion to 26 billion Btu of embodied energy based on a floor area of 1,138,035 sq. ft. The value above would represent the total embodied energy requirements based upon Mall completion. The energy sources required to construct the Mall are highly diversified, since construction materials would

be coming from sources throughout the country. As a result, the embodied energy consumption would have a very insignificant impact on local energy supplies. Local energy requirements for construction would constitute less than one-half percent of the total embodied energy requirements.

TRANSPORTATION ENERGY CONSUMPTION

As part of the analysis of energy impacts, changes in transportation energy consumption for people and goods were estimated for the market area. The total change in fuel consumption was estimated based on the change in regional traffic vehicle-miles-traveled (VMT) and the average speed of 34.5 MPH for automobiles in the study area. Delivery truck traffic serving the Mall would represent approximately 1 to 1.5 percent (200 vehicles) of the total daily design traffic (21,000-28,000 vehicles) to the Mall and hence would have a negligible impact on fuel consumption. In addition, approximately 85% of these trucks would be small trucks under 4 tons in size.

The average vehicle fuel consumption rates used for this analysis were estimated using existing fuel consumption data for automobiles[11]. These values, as shown in Figure 2, represent a composite of different vehicle types, varying in size, age and usage, driven under varying road conditions. In light of current trends towards improved fuel economy in automobiles, as a result of the Energy Policy and Conservation Act of 1975 and rising fuel costs, future fuel consumption predictions will tend to be conservative.



North Haven Mall
Valley Service Road
North Haven, Connecticut

Figure 2
Fuel Consumption of Passenger Cars

Based on these future traffic volume and speed projections, fuel consumption in the study area would decrease by approximately 535 gallons/day. This would be a result of construction of the Mall and consequent reduction of VMT (12,000 VMT) would be a direct result of three factors: (1) reductions in the number of trips made in the market area, (2) trip length reductions for shoppers using the Mall because of it's central location, and (3) improved traffic flow caused by overall traffic volume reductions. The full reduction is based on an average regional route speed of 34.5 MPH, with an associated consumption of 0.044 gallons per mile.

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